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Research Product 84-08

DESIGN GUIDELINES FOR USER TRANSACTIONS WITH BATTLEFIELD AUTOMATED SYSTEMS: PROTOTYPE FOR A HANDBOOK

Battlefield Information Systems Technical Area
Systems Research Laboratory

May 1984

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Synectics Corporation

Technical review by

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This document is a prototype of a handbook of human factors guidelines for achieving more effective user transactions with battlefield automated systems. A methodology that has proved useful in deriving guidelines for higher order aspects of human-computer interaction is described. The method is based on a comparative analysis of common or universal transactions associated with existing data processing systems. The methodology, conceptual framework, and format of the guidelines developed during the course of this project appear to provide a productive approach to improving the process of (Continued)

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"technological transfer" of data from human factors researchers to other members of system design teams involved in the design and development of battlefield automated systems. In addition, the concept of Behavioral Interoperability is propounded and discussed. Interoperability is recognized as an important design goal with respect to various physical/mechanical components of automated systems. The work here demonstrates that the concept can be productively extended to the behavioral domain.

Research Product 84-08

DESIGN GUIDELINES FOR USER TRANSACTIONS WITH BATTLEFIELD AUTOMATED SYSTEMS: PROTOTYPE FOR A HANDBOOK

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Human Performance,
Effectiveness, and Simulation

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FOREWORD

The Battlefield Information Systems Technical Area of the Army Research Institute (ARI) is concerned with helping users and operators cope with the ever increasing complexity of the battlefield automated systems by which they acquire, transmit, process, disseminate, and utilize information. Increased system complexity increases demands imposed on the human interacting with the machine. ARI's efforts in this area focus on human performance problems related to interactions with command and control centers, and on issues of system design and development. Research is addressed to such areas as user-oriented systems, software development, information management, staff operations and procedures, decision support, and systems integration and utilization.

An area of special concern in user-oriented systems is the improvement of the user-machine interface. Lacking consistent design principles, current practice results in a fragmented and unsystematic approach to system design, especially where the user/operator-system interaction is concerned. Despite numerous design efforts and the development of extensive system user information over several decades, this information remains widely scattered and relatively undocumented except as it exists within and reflects a particular system. The current effort is dedicated to the development of a comprehensive set of human factors guidelines and evaluation criteria for the design of user/operator transactions with battlefield automated systems. These guidelines and criteria are intended to assist proponents and managers of battlefield automated systems at each phase of system development to select the design features and operating procedures of the human-computer interface which best match the requirements and capabilities of anticipated users/operators.

Research in the area of user-oriented systems is conducted as an in-house effort augmented through contracts with uniquely qualified organizations. The present effort was conducted in collaboration with personnel from Synectics Corporation under contracts MDA903-80-C-0094 and MDA903-82-C-0245. The effort is responsive to requirements of Army Project 2Q263744A793, Human Performance Effectiveness and Simulation, and to special requirements of the US Army Combined Arms Combat Developments Activity (CACDA), Fort Leavenworth, Kansas.

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DESIGN GUIDELINES FOR USER TRANSACTIONS WITH BATTLEFIELD AUTOMATED SYSTEMS: PROTOTYPE FOR A HANDBOOK

EXECUTIVE SUMMARY

Requirement:

To develop a methodology that provides a framework and format for a comprehensive set of human factors guidelines for the design of user transactions with battlefield automated systems for use by human factors specialists and system proponents, managers, and developers.

Procedure:

To meet the requirements stated above, a three phase research program was initiated. Phase I was devoted to defining human factors requirements for battlefield automated systems and establishing a framework within which guidelines could be organized. In Phase II, the technical data base was further developed through search of the military and civilian literature related to user/operator transactions with automated data processing systems and a prototype handbook of guidelines was developed. When guidelines were available in the literature, they were reworded as necessary for consistency of expression and/or modified to conform to the newly established framework. Other guidelines were written on the basis of project staff experience, modulated by the results of the analytic activities during Phase I.

During Phase III, the provisional guidelines were applied to the soldier/machine interfaces of two battlefield automated system developmental programs, each at a different stage of development. These application efforts provided the basi for refinement of the format and methodology for developing such guidelines. Modifications were made to the guidelines and they were republished.

Findings:

Guidelines in the literature were plentiful in the areas of data entry and error handling. There was also substantial information on coding and display formats. Thus, approximately half of the guidelines were written by the project staff.

Utilization of Findings:

The methodology, conceptual framework and format of the guidelines developed in the course of this project appear to provide a productive approach to inproving the process of "technological transfer" of data from human factors researchers to other members of system design teams of battlefield automated systems. The development of an officially sanctioned set of guidelines will require interaction and coordination between many Army agencies. This handbook will provide a stimulus for such interaction. in the meantime, judicious application of these guidelines will improve the effectiveness of the soldier/machine interface of future systems and will promote the behavioral interoperability of these systems, i.e., increase the degree to which skills and knowledge can be transferred from one system to another.

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INTRODUCTION

This document is the final product of a three-phase project to develop a framework and format for a handbook of human factors guidelines for use by Army system developers and designers, system manufacturers, and particularly, human factors specialists serving as members of design teams of battlefield automated systems.

The first phase of the project developed a baseline of characteristics, problems and deficiencies in the soldier/machine interfaces of existing systems. This baseline provided a foundation for the second phase which comprised a literature survey and preparation of a preliminary version of a design guidelines handbook.

The object of the third phase was to evaluate the utility and usability of the initial version of the handbook. Two battlefield automated system developmental programs, each at a different stage within the Army acquisition process, served as test cases of evaluating the preliminary handbook. The first, the Vehicle Integrated Defense System - Data Management System (VDIS-DMS) is under development at the US Army Tank and Automotive Command (TACOM). Its purpose is to provide a data management/display system to coordinate the threat warning sensors, threat reaction devices and crew interaction sub-systems of tanks and other armored vehicles. The second is the Vetronics Program (also at TACOM) which has as its object the definition of the system architecture required to support the total integration of armored vehicle electrical/electronic, informational and display systems and technology within the context of the AirLand Battle 2000 concept. The results of these two evaluations are reported separately in ARI Research Note 84-28. These two application efforts provided the basis for refinement of the format and methodology for developing such guidelines. A summary of the project to develop design guidelines is reported in ARI Research Note 84-29, and the refinements have been incorporated into this latest version of the prototype for a handbook.

Comments and suggestions are invited with regard to the format and language of the handbook and the readability, understandability and/or value of this approach to guideline development for system developers, system designers, human factors specialists and other potential user groups. Address any comments to the Commander, Army Research Institute, ATTN: PERI-SF, 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

Background

The US Army is turning increasingly to the use of battlefield automated systems to meet its anticipated mission requirements. More than 70 separate automated systems for Corps area deployment are currently in a production, development or concept definition phase.

It has long been recognized that the development of complex systems must take into account the characteristics of the expected users. Over the past 40 years an expanse of knowledge has accumulated on the relationships among operator characteristics, system design and system performance. This information, although widely scattered, provides a basis for developing guidelines for human-computer interaction. Although this knowledge has been incorporated into various system design handbooks and utilized in hardware design and development, most efforts have focused on "human engineering" data, reflecting the impact of physical characteristics of a piece of equipment on operator performance. However, a major source of difficulty in designing effective battlefield automated systems devolves from less tangible aspects of user-system relationships. Thus, critical questions concerning user related characteristics (such as query language, display format, data base structure, etc), as well as issues of skill requirements and training, have remained unanswered.

In addition, it has been tacitly assumed that the advent of battlefield automation would relieve the user/operators of some of their difficult tasks and would thus reduce the number of personnel, if not the skill levels, required. Unfortunately, as has often been the case in non-military applications, the opposite result has been observed; effective exploitation of the complex technology of automation requires even greater skill levels. This problem has been compounded in the Army by the progressive mismatch between the level and number of high skill positions required in automated systems and the human resources available.

The skill/demand mismatch is due in part to the fact that the equipment/procedural configuration of existing and projected systems have been devised without coordination among proponents of different systems. As a result, very little of the skill and know-how accrued from experience with one system can be transferred to other systems. Many of the procedures employed in the operation of various systems are basically similar. Yet from the user's perspective, each system is a new situation with very little carryover

or transfer from previous exposure to other systems. While it may be too early to establish absolute "standards" for many system parameters, a measure of consistency would go a long way toward increasing effectiveness, reducing personnel costs and making battlefield automated systems more approachable to users and operators.

In the long run, effective utilization of battlefield automated systems will depend largely upon the availability of standardized procedures and techniques for user-system transactions. However, the very nature of the material acquisition process of military systems makes such standardization difficult. The constraints imposed by tight schedules and limited funds require the project manager to concentrate on a system that succeeds in achieving certain physical specifications. Concerns about interoperability with other systems, total life cycle costs or other meta-system factors are secondary. This is particularly true with respect to those aspects of system design and operation that fall within the behavioral domain.

Features that impact the users of automated information processing systems such as the data base structure, data entry method, display format, command/query language, terminology, error feedback and recovery procedures, helps/prompts, etc., are determined by the particular configuration of hardware (and accompanying software, if any) that meets certain costs and engineering criteria. The extent to which the users' cognitive, mnemonic, perceptual and other behavioral capacities are unnecessarily burdened or stressed by deficiencies in any of these features is considered peripherally, if not all.

Part of the reason is the paucity of information that a concerned system designer can use to (1) identify those features of a system that influence user performance, and (2) obtain guidance as to how to incorporate (or avoid) those features that will increase (or decrease) operator/user performance. Notable exceptions are the sets of guidelines produced by Engel and Granda (1975) and Smith and Aucella (1983).

<u>Objectives</u>

One of the major aims of the present project was to devise a format for recasting much of the previously generated human factors data into a form that makes it more digestible to other members of the system design team.

A second major objective is to propound and promote the concept of Behavioral Interoperability. Interoperability is pursued as a design goal with respect to communications, electrical characteristics, plugs/connectors and other physical attributes of information processing systems. It would appear productive to extend the concept to the behavioral domain.

To achieve behavioral interoperability it would be necessary to (1) identify and describe in operational terms those aspects of human/computer interfaces and interactions that are functionally similar; (2) create universal "task modules" for executing common transactions (see Table A for examples) as well as a body of recommended (standardized) interface design features and operating procedures derived through the application of human factors concepts and principles, or where necessary, empirical research; and (3) provide guidelines to other system design specialists that are explicit (rather than exhortatory) and are indexed and expressed in a form compatible with their needs.

Table A: Examples of Human-Computer Transaction Types

1. Specify a file to work with
2. Display a file
3. Store a file
4. Delete a file
5. Copy a file
6. Create a new file
7. Sort a file
8. Add information to a file
9. Define the format of output

Designing for behavioral interoperability between information processing systems would have two important benefits. First, it would minimize the amount of task-specific or equipment-specific training that a user would need to interact with the system upon first encounter. Second, it would minimize the skill level required to exercise the complex data processing capabilities of the system by reducing the number and complexity of operator actions.

Procedure

As an initial step, data regarding 12 tactical information processing systems were obtained via documentational analysis or interviews with authoritative members of system design teams. Included in the survey were information processing systems designed for intelligence applications (Army, Marine, Air Force), command and control, artillery fire control and logistics.

Battlefield automated systems have a large number of features that impact on human performance. In order to concentrate limited resources and minimize intrusion into the busy schedules of personnel from whom system data were solicited, the survey was deliberately limited in scope. Eight "design features" that significantly impact the soldier/machine interface and are common to all battlefield automated systems were selected somewhat arbitrarily. They represent a pragmatic collection of design feature categories requiring priority attention rather than the elements of a comprehensive taxonomy of soldier/machine interface issues.

For the sake of consistent exposition, the guidelines data associated with all of the design feature categories were assembled within a single, structured format. This format was designed to aid system developers and system engineers in selecting appropriate design features for particular systems and, at the same time, to increase the degree of behavioral interoperability between various systems. Accordingly, each set of guidelines was formulated in terms of the elements shown in Table 2.

In developing the specific guidelines presented under the "Recommendations" and "Advisory Comments" topics in each subsection, heavy use was made of material presented by Engel and Granda (1975), Ramsey, Atwood, and Kirshbaum (1978), Ramsey and Atwood (1979), Smith (1979, 1980), and Williges and Williges (1981). The majority of these guidelines were reworded or entirely rewritten to achieve consistency of style in the handbook, to provide greater emphasis, to sharpen their focus on specific transaction types, to remove psychological jargon, or to increase their clarity of expression. They were then distributed according to the organizing framework in Table 1 and, in the case of "Advisory Comments," according to the techniques described under "X.X.4 Methods."

Many guideline areas in Table 1 are not addressed in the civilain or military literature, or are addressed only generally or sparsely. For these areas, guidelines were developed on the basis of the knowledge and experience

of the project staff. Guidelines for individual sections of the prototype handbook were prepared by different personnel and then reviewed by other personnel. Differences of opinion were resolved through discussion.

Guidelines in this category comprise perhaps half the total volume of the prototype handbook. Such guidelines, of course, are as yet neither supported nor challenged by the results of research, and inevitably they reflect the collective prejudices of the project staff. Nonetheless, they reflect application in human-computer interface development efforts on which project personnel have worked. More importantly, they also reflect solutions devised for problems and deficiencies observed during the analytical activities of the first phase. They are therefore believed to represent reasonable guidance for the design of user-computer transactions with battlefield automated systems.

Those readers who wish to consult the literature surveyed in preparation for developing these guidelines will find a supplemental Bibliography at the end of this document. They would be well advised, however, to begin with the excellent review by Ramsey and Atwood (1978), and the monumental annotated bibliography compiled by Ramsey, Atwood, and Kirshbaum (1978).

Table 1. Organizing Framework for Guidelines and Criteria for this Document.

1. Control Methods
    1.1 Alphanumeric Control Methods
    1.2 Graphics Control Methods
    1.3 HELPs
2. Display Techniques
    2.1 Alphanumeric Displays
    2.2 Graphics Displays
    2.3 Selective Highlighting
3. Data Entry and Handling
    3.1 Information on Legal Entries
    3.2 Unburdening of Input
    3.3 Interrupts and Work Recovery
4. Message Composition Aids
    4.1 Alphanumeric Messages
    4.2 Graphics Displays
5. Data Retrieval Assistance
    5.1 Query Method
    5.2 Query Structure
6. Symbology and Terminology
    6.1 Symbols and Symbol Sets
    6.2 Standard Terms
    6.3 Abbreviations and Codes
    6.4 Full Language
    6.5 Glossaries
7. Error Handling
    7.1 Error Feedback
    7.2 Error Correction/Recovery
8. User/Operator Configurations

Table 2. Organization of the Topics in Each Subsection of the Guidelines and Criteria.

X.X.1	DEFINITION. Defines the category of guidelines and criteria covered in the subsection.
X.X.2	APPLICATIONS. Describes the situations to which guidelines and criteria in the subsection apply. Examples are provided to illustrate the applications.
X.X.3	BENEFITS. Describes the ways in which utilization of the guidelines will enhance system performance. Descriptions of benefits, interpreted in terms of the specific system's characteristics, can be translated into evaluation criteria.
X.X.4	METHODS. Describes specific methods for implementing the guidelines in the subsection. Examples are provided liberally to clarify each method.
X.X.5	RECOMMENDATIONS. Contains specific guidelines which apply across all methods in the subsection. The first recommendation in each subsection is a matrix of applications versus methods, suggesting specific methods to use for each application.
X.X.6	ADVISORY COMMENTS. Contains specific guidelines for each method in the subsection.

Using This Handbook

The reader consulting this prototype handbook about a particular issue in the design of the soldier-system interface will probably gain the greatest utility by following these steps:

1. Check the Table of Contents to locate the major section that appears most likely to contain the desired information.

2. Read the first page of the section; it provides an overview of the section and briefly describes each subsection.

3. Turn to the subsection that appears to be most appropriate to the issue of concern. (Table 1 lists the sections and subsections.)

4. Read the DEFINITION of that subsection to ensure that it does indeed contain the desired information (Table 2 lists the six topics in each subsection.)

5. Examine the APPLICATIONS and locate the one of greatest interest.

6. Take a moment to read the BENEFITS topic. It explains why guidelines in this subsection are useful in interface design. This topic also provides the basis for developing evaluation criteria, given information about specific system characteristics.

7. Read about the METHODS that are used to implement the various applications in the subsection.

8. RECOMMENDATIONS provide guidelines that apply to all the methods described in the subsection. The first recommendation is a matrix suggesting the preferred method to use for each application. Check the matrix for the best method for your particular application, then read the remaining recommendations for general guidance.

9. Finally, consult the ADVISORY COMMENTS regarding the selected method. These are recommendations focused on each specific method, and they should not be ignored in designing the soldier-system interface.

SECTION 1. CONTROL METHODS

Guidelines in this category deal with methods for allowing users/operators to control the processes of the hardware and software components of the system. The guidelines discuss what methods, or combinations of methods, are most appropriate for given combinations of user types, hardware and software characteristics, and environmental factors. Three aspects of control methods are considered:

1. Alphanumeric Control Methods, characterized by a requirement for the user/operator to learn and apply a language which the system "understands."

2. Graphics Control Methods, techniques employing imagery, symbology, and pictorial representation by which users/operators may define desired system operations.

3. HELPs, methods for presenting information and instruction to the user/operator which "cue" system operation.

1.1 Alphanumeric Control Methods

1.1.1 DEFINITION

Alphanumeric control methods are dialog types made up of alphabetic, numeric, and usually also the standard grammatical symbol sets, by which users/operators communicate their instructions to the computer through the computer terminal.

1.1.2 APPLICATIONS FOR ALPHANUMERIC CONTROL METHODS

Alphanumeric control methods are used to control the operation of ADP systems.

1.1.3 BENEFITS OF ALPHANUMERIC CONTROL METHODS

Selection of a good dialog type will make it easier for the user/operator to indicate to the computer system what operations are to be performed. Use of alphanumeric commands as a form of system control will enhance overall system performance by:

a. Reducing error rates, by minimizing:

   1. Probability of error in specification of command strings.
   2. Errors associated with recall of commands.
   3. Errors associated with carrying the command structure in short-term memory after viewing HELP files.
   4. Entry of non-disambiguable command strings.
   5. Inherent error rate of command interpretation.
   6. Errors due to fatigue on the part of users/operators.

b. Increasing throughput rates, by reducing time required to:

   1. Enter commands.
   2. Look up command meanings, content, and/or formats in system reference documentation.
   3. Access command HELP files.
   4. Reenter invalid commands.
   5. Reorient hands and eyes when using behaviorally conflicting command modes.

c. Reducing user/operator frustrations, by minimizing:

   1. The necessity to refer to system documentation.
   2. The amount of time spent entering default or sequence continuation commands or characters.

1.1.4 METHODS FOR ENTERING ALPHANUMERIC CONTROLS

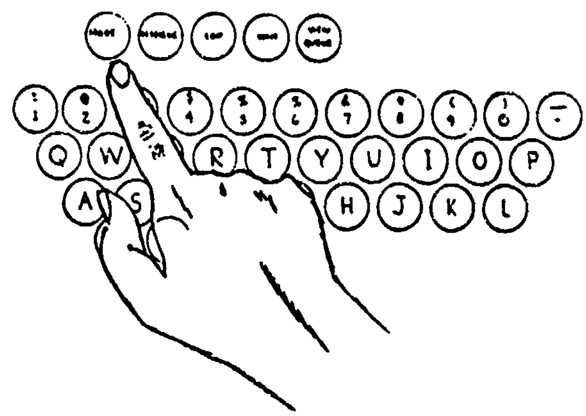
a. Question and answer dialog, in which the computer system asks the user/operator specific questions. In the simplest form of this type of dialog, the user/operator may respond only with "Y(ES)" or "N(O)." In more complex forms, the user/operator may be required to respond with a number or a code for a command.

```
DO YOU WISH TO RETRIEVE INFORMATION? -->
DO YOU WISH TO CREATE A NEW FILE?    -->
DO YOU WISH TO STORE INFORMATION?    -->
```

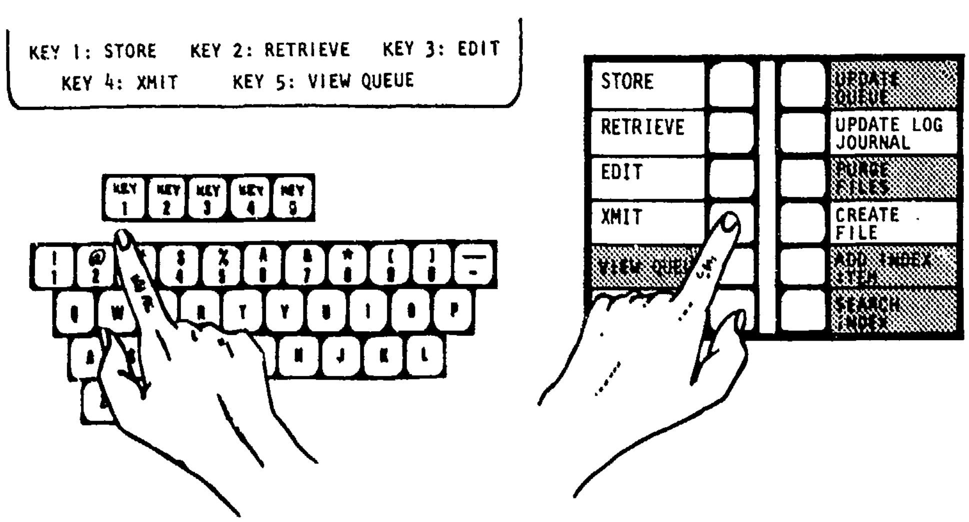
b. Form filling, in which the user/operator fills out a form or questionnaire presented at the terminal. The entries in the "blanks" may be words, codes, numbers, or merely symbols (e.g., "checkmarks") to indicate that the user/operator wishes to perform the operation displayed on the screen.

```
USER CODE NUMBER:______-__-___ ID NUMBER:_____-__
CHARGE CODE:___-__/__ DATA FILE DESIRED:______:__:__
ACTIVITY: STORAGE:__ RETRIEVAL:__ EDITING:__
OPTIONS:____ ____
        ____ ____
        ____ ____
        ____ ____
HARD COPY DESIRED? (Y/N):__
```

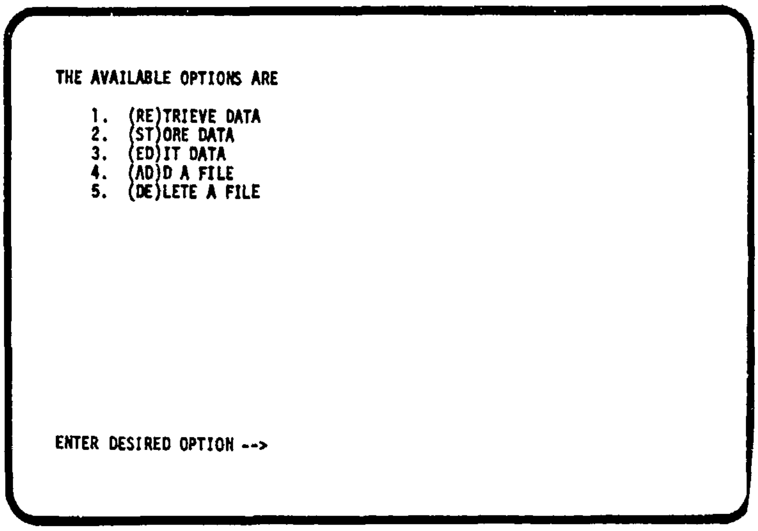
c. <u>Fixed function keys</u>, in which the user/operator presses a special key on a terminal keyboard to indicate to the computer that a particular operation should be performed. The keys are labeled with the operations which the system is to perform.



d. <u>Variable function keys</u>, in which the user/operator presses a special key to indicate to the computer system that a particular operation should be performed. A variable function key may perform different functions, depending on what kind of activity the user/operator is performing. Usually the specific effect of pressing a given variable function key is indicated by a brief menu presented on the terminal or on transparent key label overlays or underlays.

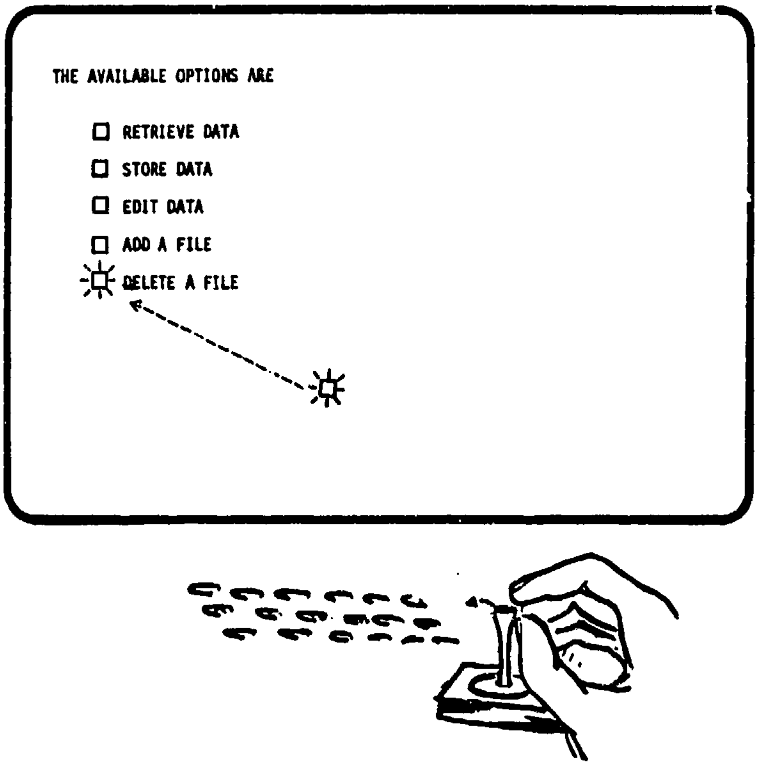


e. Menu selection, in which the user/operator selects a desired command from a list of commands presented on the display. The user/operator then enters the code, word, or number associated with that command.

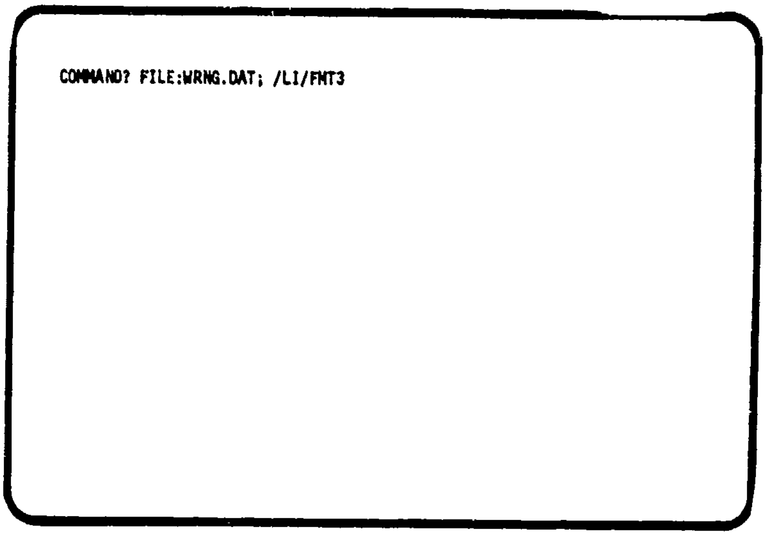


f. Light pen dialog, which is usually a special form of menu dialog in which the user/operator touches a light pen to the option that identifies the command which the user/operator desires.

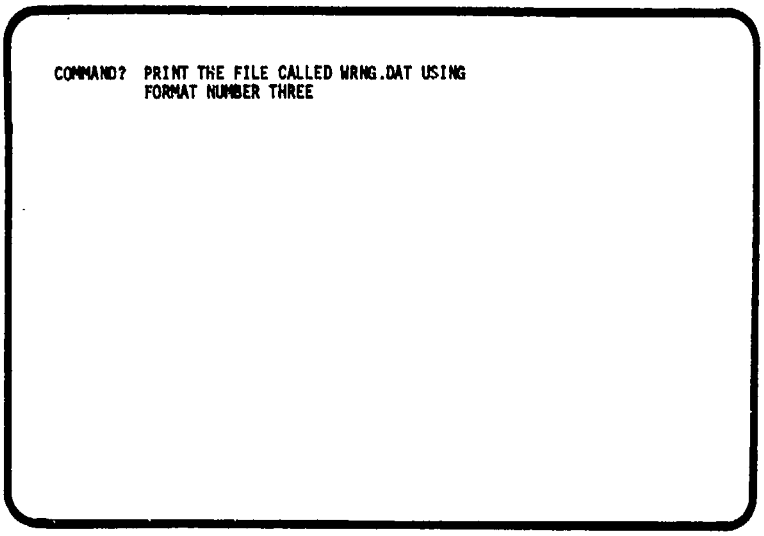
g. Cursor control dialog, which is usually a special form of menu dialog, in which the user/operator positions the screen cursor next to the desired command. The cursor may be moved with any graphic positioning device. In the example below, the user/operator is using a joystick.



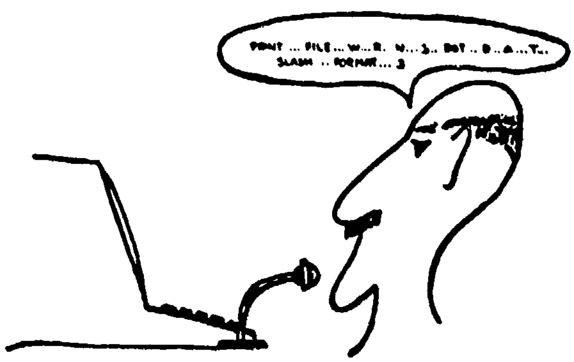
h. User-initiated command language dialog, in which the user/operator enters commands in response to a prompt symbol appearing on the terminal. The prompt is typically brief, so the user/operator must remember the command codes and options and accuratel· type them at the terminal.



i. Natural language dialog, which typically is user-initiated command language, in which the designer attempts to make the command language as much like standard English as possible.



j. Voice input, which is typically a form of user-initiated command language, where the user/operator speaks commands instead of typing them.



1.1.5 RECOMMENDATIONS FOR ALPHANUMERIC CONTROL METHODS

Selection of the dialog type depends on the nature of the system being developed and the characteristics of the expected users/operators of the system. Some of the most important factors in making this decision are:

a. Sophistication of the users/operators.

1. HIGH level of sophistication means that users/operators are very familiar with the system, its capabilities, and the sequences of operations which the system will perform. Users/operators with a HIGH level of sophistication will have (a) received a substantial amount of training in system operation or (b) had considerable experience in operating the system by the time they are called on to use it in operational situations, or (c) both of the above.

2. MEDIUM level of sophistication means that users/operators are quite familiar with the most important capabilities and commands of the system, but are not intimately familiar with little-used system features. Users/operators with a MEDIUM level of sophistication may have received considerable training, but will not have used the system enough to maintain their knowledge about all of the system's capabilities.

3. LOW level of sophistication means that users/operators are familiar only with the "big picture" of system operation. They may be unfamiliar with the range of capabilities of the system.

4. VARIABLE level of sophistication means that different users/operators have different levels of sophistication in using the system. Some may be very familiar with its features and capabilities, while others will be aware of only the most elementary or important features.

b. Number of Commands

1. VERY HIGH--more than 300 separate commands and command options.

2. HIGH--151 to 300 separate commands and command options.

3. MEDIUM--51 to 150 separate commands and command options.

4. LOW--50 or fewer separate commands and command options.

c. Number of times an average command will be used by a typical user/operator in a given period of time.

1. HIGH--average command used 5 times per day or more.

2. MEDIUM--average command used twice per week or more but less than 5 times per day.

3. LOW--average command used less than twice per week.

d. <u>Computer-to-terminal data transmission rate.</u>

1. HIGH--4800 baud (480 characters per second) or greater.

2. MEDIUM--1200 baud (120 characters per second) or greater, but less than 4800 baud (480 characters per second).

3. LOW--less than 1200 baud (120 characters per second).

Table 1.1-1, Dialog Type by System and System User Characteristics, presents a general list of recommendations for selecting dialog types. Before making a final decision on dialog type, be sure to consult the advisory comments for individual dialog types presented in the next section (Section 1.1.6, Advisory Comments for Alphanumeric Contract Methods).

To use the table, first decide what system and system user characteristics apply to the situation you are considering. Eliminate any dialog types where a "4" appears as an entry. Select the best dialog type by comparing the remaining types in view of the type of system you are conceptualizing or designing.

Table 1.1-1. Dialog Type by System and System User Characteristics

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

DIALOG TYPE	CHARACTERISTIC OF SYSTEM OR SYSTEM USER: SOPHISTICATION OF USERS				NUMBER OF COMMANDS				EMPLOYMENT OF AVERAGE COMMAND			COMPUTER-TO-TERMINAL DATA TRANSMISSION RATE		
	HIGH	MEDIUM	LOW	VARIABLE	VERY HIGH	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW
QUESTION AND ANSWER DIALOG	4	3	2	3	4	4	1	1	3	2	1	1	2	3
FORM FILLING	3	3	2	2	4	4	2	1	2	2	2	1	2	4
FIXED FUNCTION KEYS	1	1	1	1	4	4	4	1	1	2	3	1	1	1
VARIABLE FUNCTION KEYS	1*	2	2	2	3	3	2	1	1*	2	3	1	1*	1*
MENU SELECTION	2	1*	1*	1*	2	2	1*	1*	3	2	1*	1*	2	4
LIGHT PEN DIALOG	4	3	1	2	3	3	2	1	4	3	1	1	2	4
CURSOR CONTROL DIALOG	4	3	1	2	3	3	2	1	3	2	2	1	2	4
USER-INITIATED COMMAND LANGUAGE	1	2	3	3	1	1	2	2	1	2	4	1	1	1
NATURAL LANGUAGE DIALOG	4	3	2	2	2	2	3	3	2	1	2	1	1	1
VOICE INPUT	2	2	2	2	3	2	1	1	1	2	3	1	1	1

*Recommended as 1st choice for standardization purposes.

1.1.6 ADVISORY COMMENTS FOR ALPHANUMERIC CONTROL METHODS

a. Question and answer dialog

1. Use question and answer dialogs only when the users/operators are likely to be very unsophisticated in using system capabilities.

2. Use question and answer dialog when the users/operators are required to provide only "YES" or "NO" answers to questions generated by the computer systems.

3. Use question and answer dialogs when the user/operator is required to enter information which cannot be placed on a list or easily encoded (e.g., time other than current time; number of troops).

4. When using question and answer dialogs, provide examples of required command format and content whenever possible.

b. Form filling

1. Use form filling when the user/operator is typing in commands which have been written or typed previously on a hard copy form.

2. When using form filling, provide a convenient means to control cursor movement from field-to-field as well as from line-to-line and character position-to-character position.

3. When the user/operator is using form filling to enter commands written or typed on hard copy, make the image of the form displayed on the CRT screen look as much like the hard copy form as possible.

4. Avoid using form filling when the system must handle multiple form types and the computer-to-terminal data transmission rate is low. In this situation, it will take too long to display the different forms when the user/operator must shift from form-to-form.

c. Fixed function keys

1. Use accurately labeled fixed function keys when users/operators are likely to be very unsophisticated in the use of computer systems and the command set is small.

2. Group fixed function keys by purpose, type of data involved, etc.

3. If fixed function keys are enabled only at certain points during system operations, and are disabled at other times, provide a light behind each key which is ON when the key is enabled.

d. Variable function keys

1. When a constant set of commands is available at all points in system operation, place these commands on the same variable function keys throughout system operation. Note: from the standpoint of the user, these become fixed function keys.

2. As much as possible, place command labels on, in, or beside variable function keys rather than listing options in menu form on the display and numerically or alphanumerically encoding the function keys.

3. Where long-term usage of a particular variable function key configuration is likely, provide key caps or other labeling overlays/underlays to differentiate variable function keys.

4. Where different users/operators use the same terminal and system for different purposes, provide each user/operator with a set of overlays/underlays to designate the commands associated with particular variable function keys for each particular application.

e. Menu selection

1. Use menu dialogs when the command set is so large that users/operators are not likely to be able to commit all commands to memory.

2. Where there are logical relationships among commands, present groups of menus in a sequence which is in accordance with those logical relationships. For example, where commands are hierarchical, arrange the menus in a sequence from general to specific command formulation.

3. Use menu dialogs where at least some of the users/operators may not be familiar with all of the functions of the system.

4. Where there is a wide difference in the sophistication of the set of expected users/operators, present menus of different levels of detail.

5. Where some of the users/operators are, or will become, very sophisticated in system operation, provide a method for bypassing menu displays by stacking commands, i.e., entering a whole set of commands in anticipation of upcoming displays. This recommendation is particularly important where the data transmission rate available will require that the time to display the menu will exceed two seconds. (See Figure 1.1-1.)

f. Light pen dialog

1. Use a light pen dialog in systems where the users/operators are likely to be unfamiliar with the commands and functions of the system.

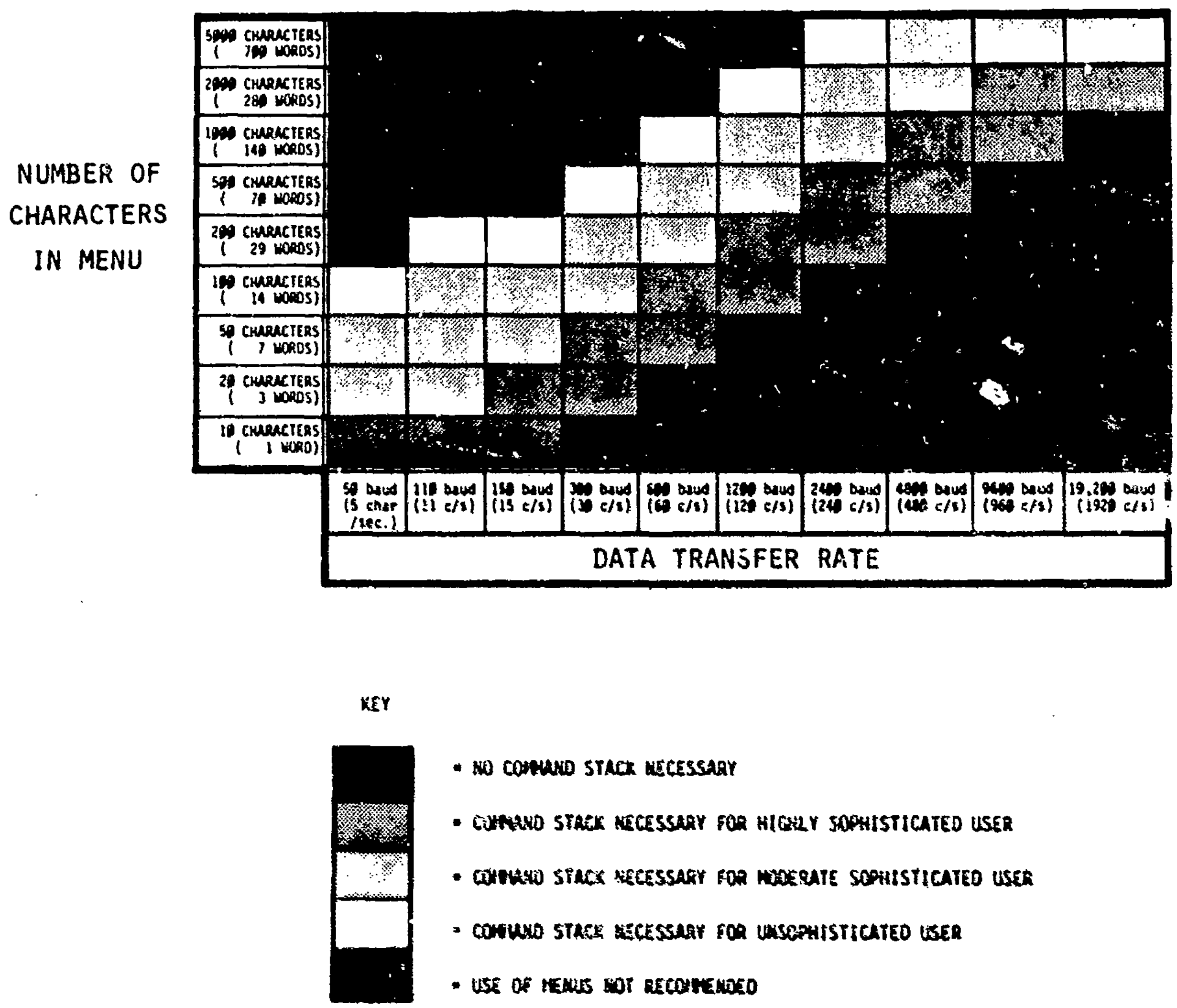


Figure 1.1-1. Requirements for Command Stack Given Various Combinations of Characters in Menus and Data Transmission Rates.

2. When using a light pen dialog, make certain that the "targets" for the light pen are at least 1/4" square.

3. If the user/operator is to use the light pen for more than 1/4 hour continuously, place the display screen in a horizontal or nearly horizontal position so that the user/operator does not tire.

4. If the user/operator must make light pen transactions more frequently than one every five minutes, place the display screen in a horizontal or nearly horizontal position so that the user/operator does not tire.

5. Avoid using light pen dialogs where the users/operators of the system will be highly sophisticated in system functions and operations.

g. Cursor control dialog

1. Use a cursor control dialog when conceptualizing or designing systems which have interactive graphics as their primary purpose, but which must use alphanumeric menu presentation in some processing steps.

2. Avoid using a cursor control dialog when the users/operators of the system will have no need to control the position of the cursor on the CRT screen other than to select items from an alphanumeric command menu or list.

3. Use the same method for the cursor control dialog as is used for graphics interaction.

4. When using a cursor control dialog, make the "target" for the cursor at least 10 times the size of the positioning accuracy required for interactive graphics or 1/4" square, whichever is smaller.

5. Provide feedback to the user/operator on which "target" has been selected by the cursor control dialogs. Making the selected target brighter is the preferred method. (See Section 2.3, Selective Highlighting.)

h. User-initiated command language

1. Use user-initiated command language when sophisticated users are working with a system having a large number of capabilities.

2. Before committing to command language dialog, be sure to check the implications of command language code structure and syntax presented in the discussion of alphanumeric formats for message composition aids presented in Section 4.1.

i. Natural language dialog

1. Use natural language dialog where unsophisticated users/ operators must use a system with a moderate number of commands.

2. Use natural language dialogs when the set of commands can be made to reflect usage of common English language terms.

3. Where some sophisticated users will use a system with natural language dialog, provide for command codes and abbreviations as an option to natural language interaction.

j. Voice Input

1. Use voice inputs where the user's/operator's hands and eyes are already being used extensively in other system operations. For example, voice inputs might be useful in an interactive graphics system.

2. Limit the use of voice input to situations where the ambient noise level is less than 90 dBA.

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1.2 Graphics Control Methods

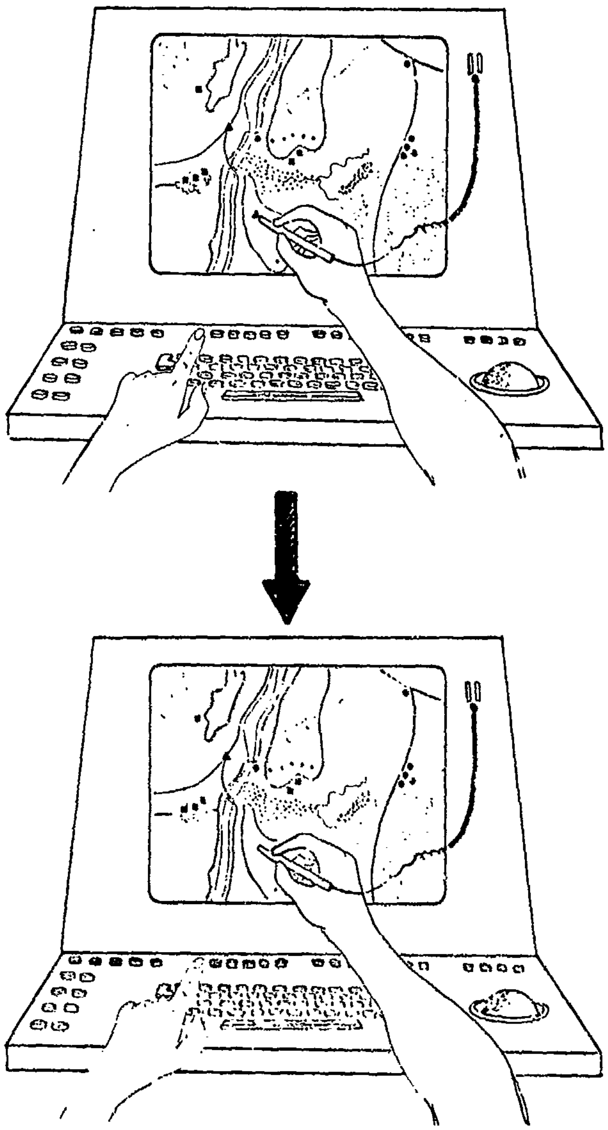
1.2.1 DEFINITION

Graphics control methods are techniques used to specify, alter, define, or otherwise stipulate the appearance of graphics displays. These displays may be either hard copy (as on a plotter or printer/plotter) or generated on a graphics terminal.

1.2.2 APPLICATIONS FOR GRAPHICS CONTROL METHODS

a. Selecting or specifying graphics commands. In this application, the user or operator indicates to the computer system what graphics functions he/she wishes to perform. Graphics functions include: adding symbols to the display, moving symbols on the display, deleting symbols from the display, etc.

EXAMPLE: In an artillery fire control system, the CRT display shows the position of targets by "overlaying" them on a map of the battlefield area. The user/operator has received information that one of the targets has been destroyed, so he/she wishes to delete the symbol which depicts that target. To do this, the user/operator presses a fixed function key marked "SYMBOL DELETE," touches a light pen to the symbol to be deleted, and presses the "execute" button on the light pen.

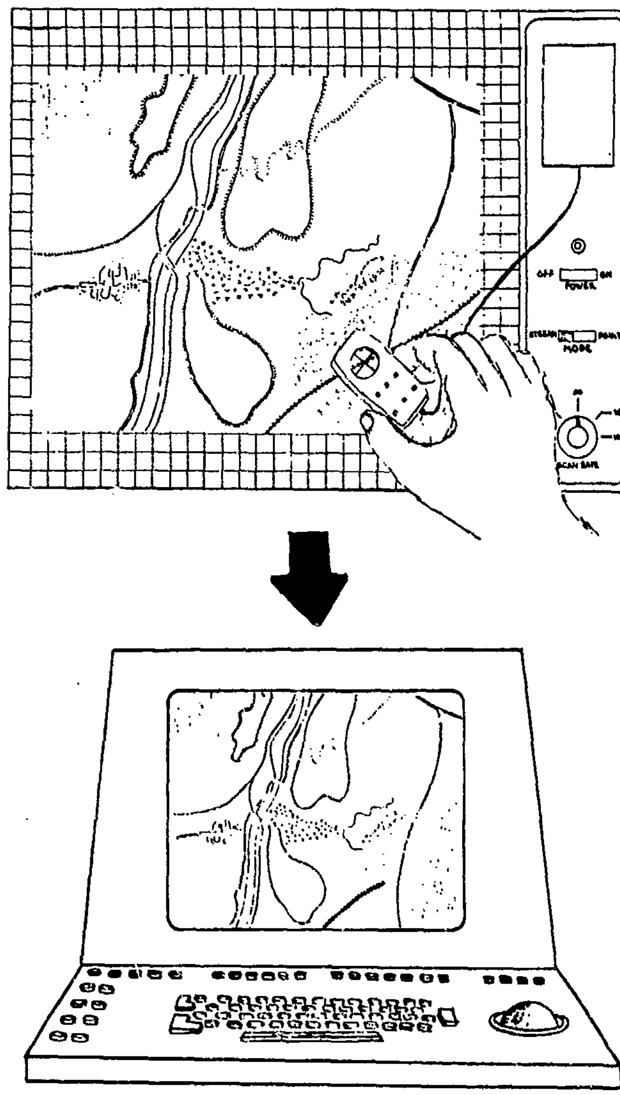


b. Sketching or drawing lines on the display. The user or operator uses a graphics control device to sketch lines on the display. In many ways, this is similar to using a piece of chalk to draw on a blackboard.

EXAMPLE: In a command and control system, the operator of a battalion-level component of the system can send graphics displays to division and higher echelons. The division commander requests information on the routes which enemy forces are expected to take to engage the battalion. The battalion commander has the system operator call up a display of the battlefield area. He/she then uses a light pen to sketch the most probable routes of the enemy's advance. The operator sends the altered display to the division-level component of the system.

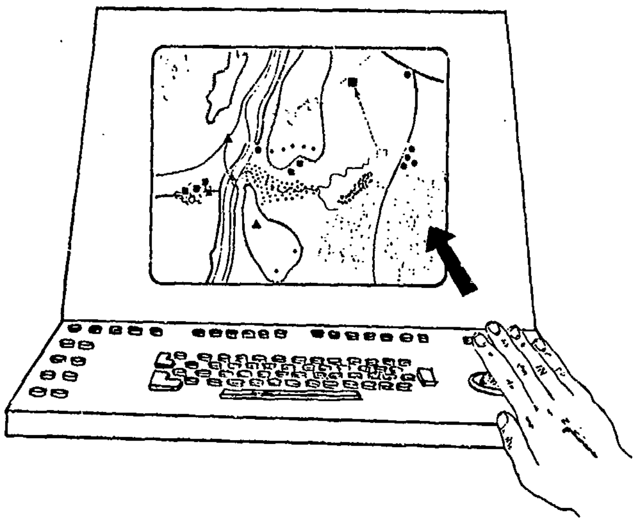
c. Following detailed lines from hard copy. Some information which a user or operator may wish to place on a graphics display is available only in the form of maps or charts. To place this type of information (roads, contour lines, railroads, etc.) onto the graphics display, the user/operator must essentially "trace" the lines from the hard copy. In some applications very accurate "tracing" may be required.

EXAMPLE: While working on an intelligence system, the user/operator receives a chart showing the location of a new railroad spur. This information is to be added to the map data base of the intelligence system. The user/operator tapes the chart to a digitizing tablet, registers the chart to the corresponding map in the intelligence map data base, and follows the route of the new railroad spur with digitizing cursor on the digitizing tablet. The railroad route is transferred to the CRT map image.



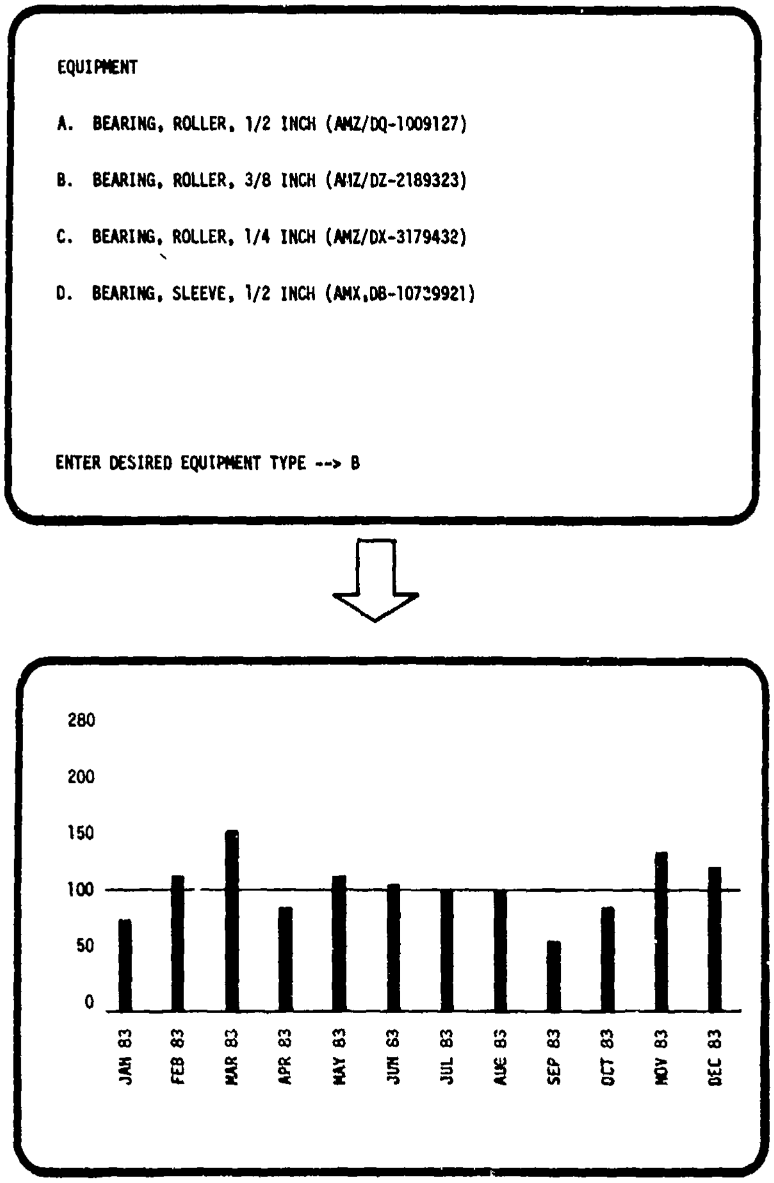
d. Placing and moving symbols on the display. In many types of graphics displays, the user or operator is required to alter the display by placing new symbols on it, moving existing symbols, or deleting existing symbols.

EXAMPLE: In a command and control system, the user/operator receives messages from field commanders describing in general the position of the Army units which he commands. Exact coordinates are not given. The user/operator interprets these messages, retrieves a digital version of a chart which corresponds to the position of the units, and moves the units to a new chart position using a trackball.



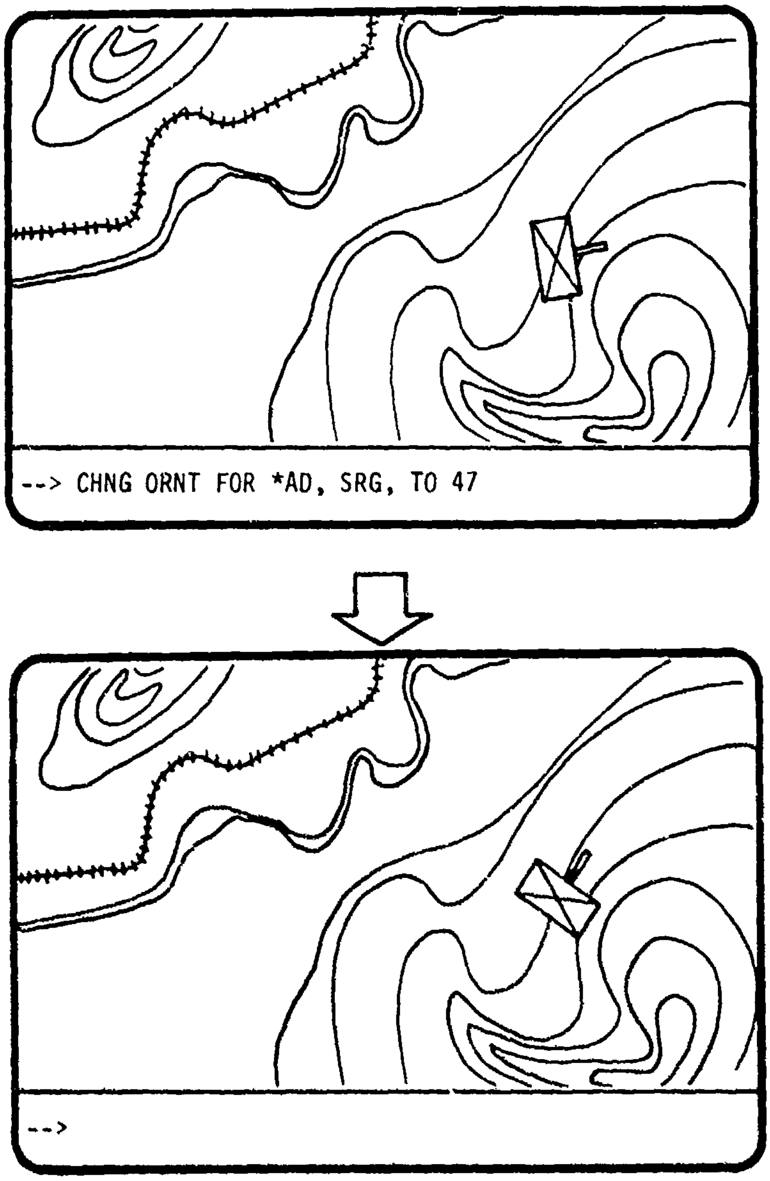
e. Selecting display parameters. In some graphics applications, the user/operator will decide that only a certain class of symbols be presented on a display. The user/operator must therefore have the capability to indicate what information he/she wishes to be displayed.

EXAMPLE: In a logistics/supply system, the user wishes to review the history of stocks of equipment types. The user enters the equipment type code, and the system displays the percentage of authorized stock levels over the last 12 months.



f. Orienting symbols. In some graphics systems, the orientation (or direction of pointing) of symbols may be important, regardless of the position of the symbol on the display. The user or operator must have the capability for specifying this orientation.

EXAMPLE: An artillery unit has shifted its firing orientation from 85° to 47°. The user of an artillery fire planning system wishes to change the indicated orientation of that unit so that displays including the artillery unit show the current orientation. The user changes the value for orientation of the artillery unit by entering a command which changes the orientation value from 85° to 47°.



1.2.3 BENEFITS FOR GRAPHICS CONTROL METHODS

Graphics control methods should enable users/operators to quickly and easily specify and/or modify the contents of the displays which they are using. Appropriate selection of graphics control methods can have the following benefits:

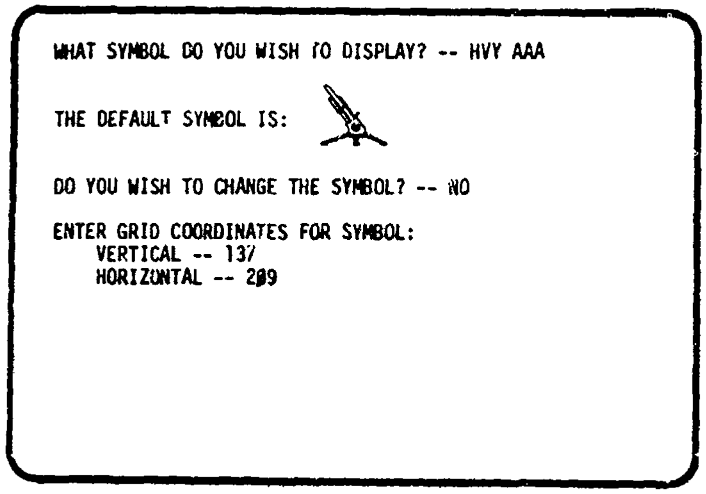
a. Reduced time to alter the displays to conform to the requirements of a particular battlefield situation.

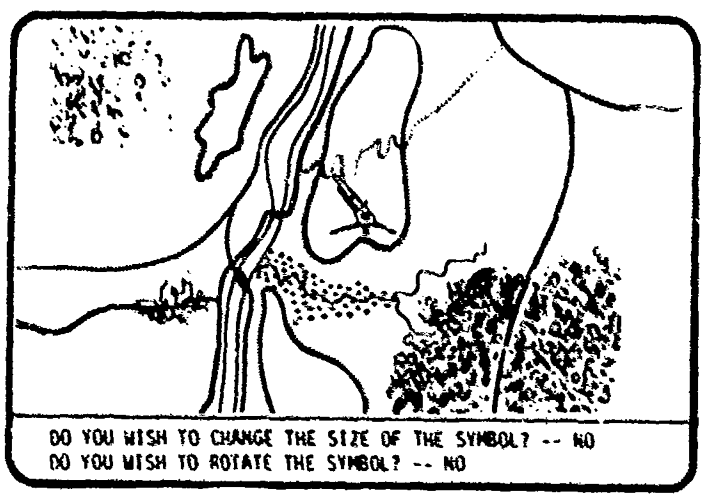
b. Reduced errors in selecting symbols or specifying the kinds of symbols which are to be included in the display.

c. Reduced operator fatigue, which could result from using graphics control methods which are ill-suited to the physical and/or behavioral characteristics of the users/operators.

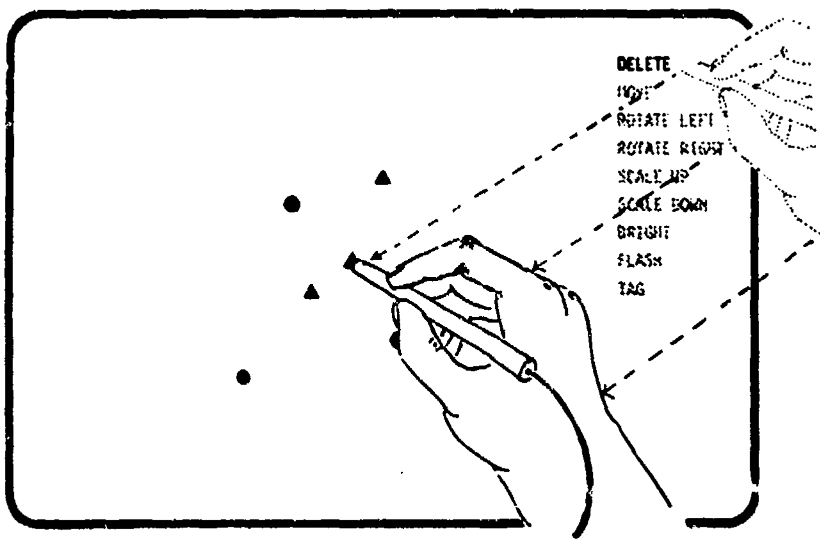
1.2.4 METHODS FOR GRAPHICS CONTROL METHODS

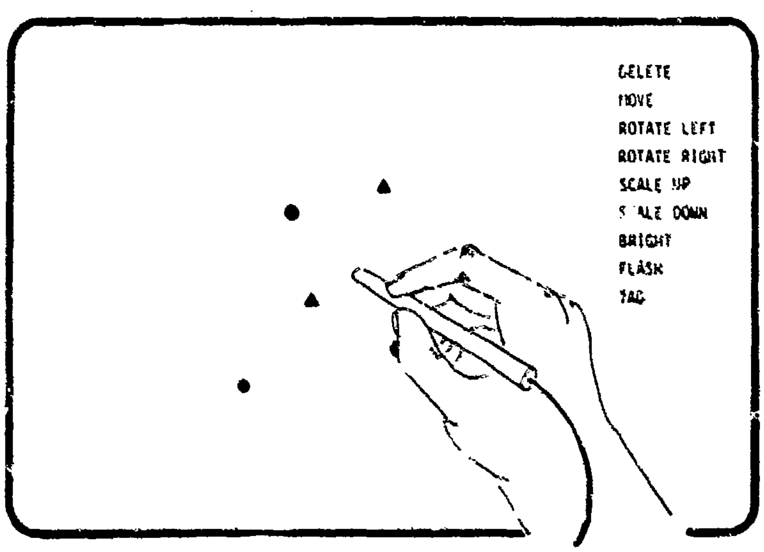
a. Alphanumeric interaction dialog. The appearance, placement, and movement of graphics symbols on a display can be controlled by the types of alphanumeric dialog discussed in Section 1.1, Alphanumeric Control Methods.



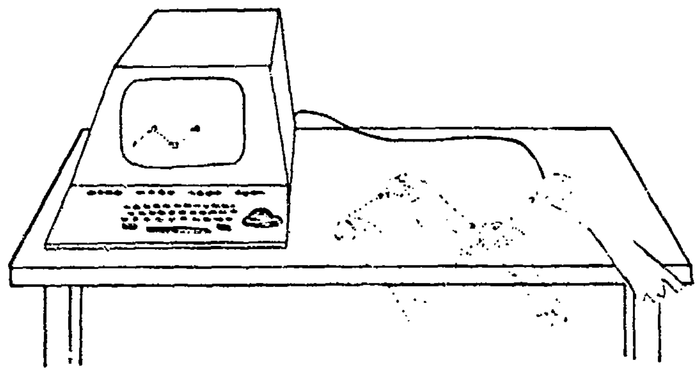


b. Ligh pen/light gun. The user/operator points the light gun to the desired command or symbol, and "drags" symbols around on the display to create the desired graphic image.

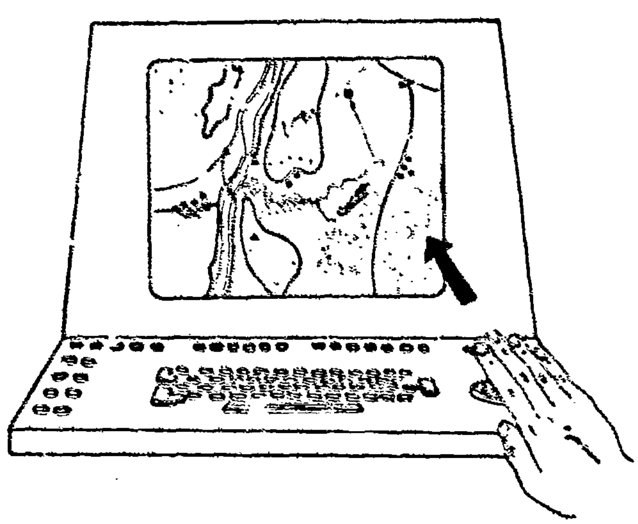




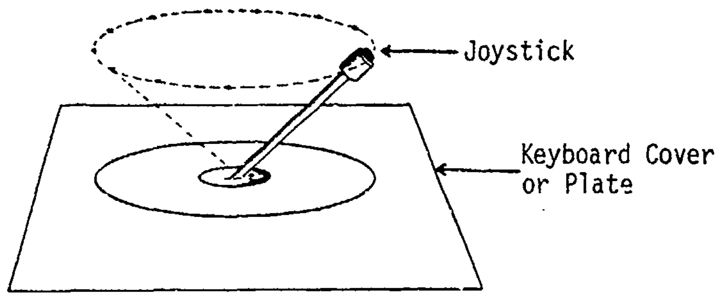
c. Mouse. The user/operator pushes a small wheeled device, a "mouse," around on a flat surface. The direction of motion of the device is transmitted to the display, where a screen cursor indicates the relative position of the "mouse."



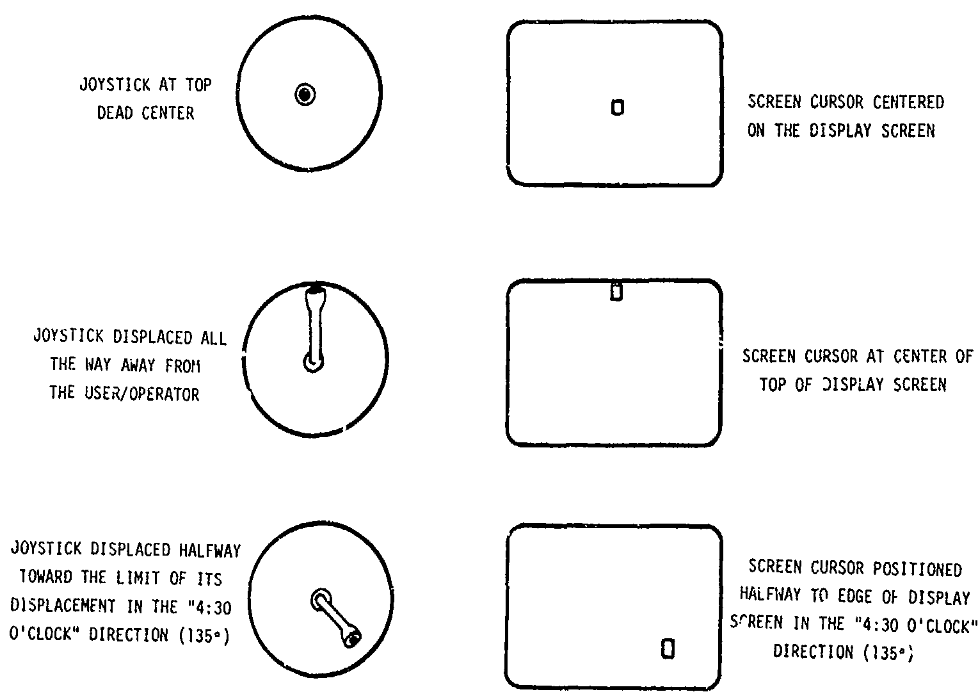
d. Trackball. The user/operator rotates the top surface of a ball which is partially buried in the surface of the keyboard panel (or in a separate trackball case). The direction of motion of the screen cursor is determined by the direction in which the top of the ball is moved. The speed of motion of the screen cursor is determined by the rate of rotation of the ball.



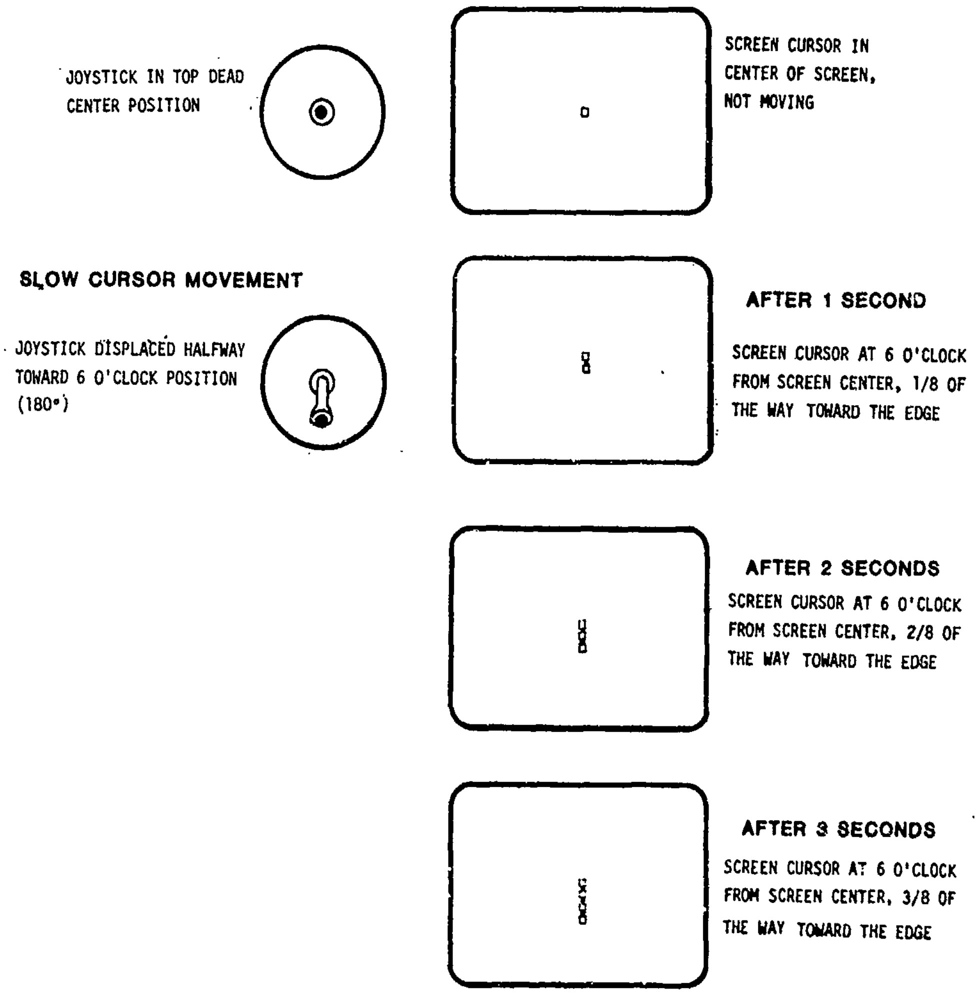
e. Joystick. The user/operator moves a vertical lever or "stick" which is implanted in the top surface of the keyboard panel (or in a separate joystick case). Most joysticks are mechanically configured. They resemble a rod stuck into a ball which has been bored in the top of the keyboard cover, and they move smoothly throughout the cone of rotation.



1. Direct positioning joystick. With this type of joystick, the cursor moves in the direction of the movement of the joystick. The speed of cursor movement is determined by the speed with which the joystick is moved. The distance to which the cursor moves is dependent upon the extent of displacement of the cursor, i.e., the angle of the cursor relative to the plate in which it rests.

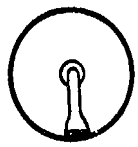


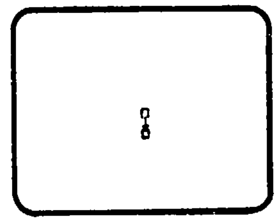
2. Relative positioning joystick. In this configuration, the cursor also moves in the direction of the movement of the joystick. But, the speed of cursor movement is dependent upon the extent of displacement of the joystick (i.e., its angle relative to the plate) rather than joystick movement and the cursor continues to move across the screen in the given direction as long as the joystick is displaced. Thus, in this instance, the distance the cursor moves is dependent upon the combination of time and extent of joystick displacement.



FAST CURSOR MOVEMENT

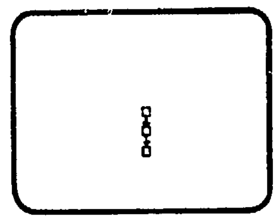
JOYSTICK DISPLACED FULLY TOWARD 6 O'CLOCK DESTINATION (180°)





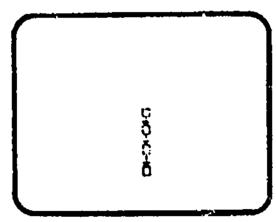
AFTER 1 SECOND

SCREEN CURSOR AT 6 O'CLOCK FROM SCREEN CENTER, 1/4 OF THE WAY TOWARD THE EDGE



AFTER 2 SECONDS

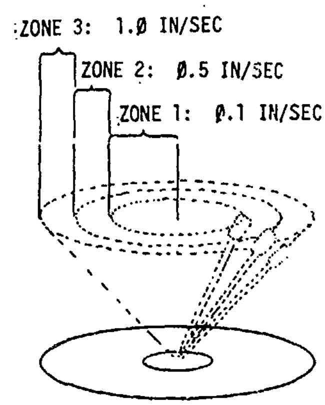
SCREEN CURSOR AT 6 O'CLOCK FROM SCREEN CENTER, 2/4 OF THE WAY TOWARD THE EDGE



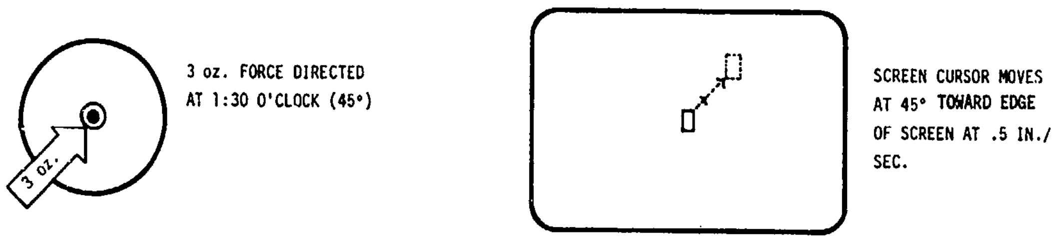
AFTER 3 SECONDS

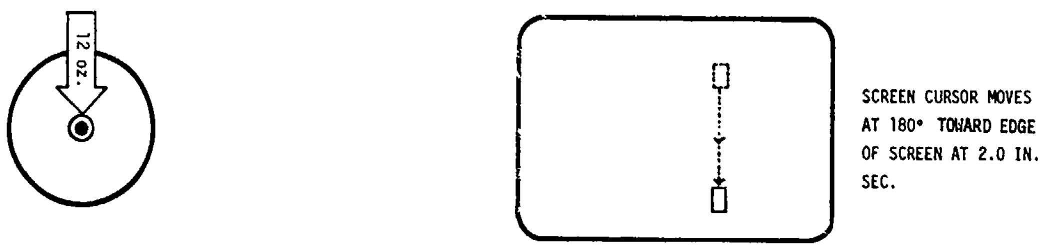
SCREEN CURSOR AT 6 O'CLOCK FROM SCREEN CENTER, 3/4 OF THE WAY TOWARD THE EDGE

3. Stepping or detent joystick. Displacement of the joystick from its top dead center position results in a constant rate of motion of the screen cursor until a particular angular rate of displacement is reached. In the second zone, the screen cursor moves faster than in the first; in the third zone faster yet, etc. Usually, moving from one zone to a faster one requires an increase in force on the joystick lever. This assures that the user/operator will know that the rate of cursor movement is changing. There are ordinarily three "zones" in this type of joystick implementation.



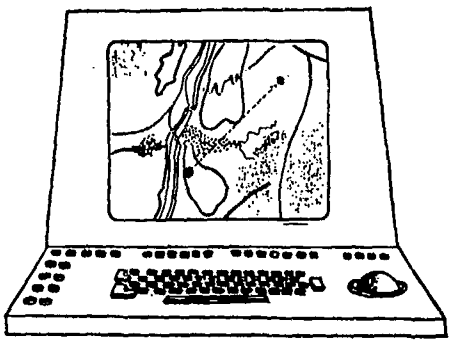
4. Piezoelectric or strain gauge joystick. In this configuration the joystick lever is not movable. The direction of movement of the screen cursor is determined by the direction of the pressure on the lever. The speed of movement is determined by the amount of pressure applied.

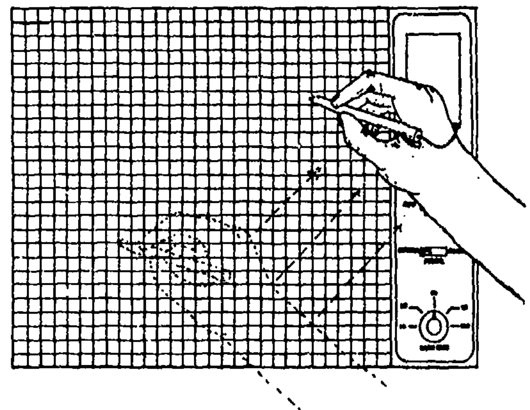




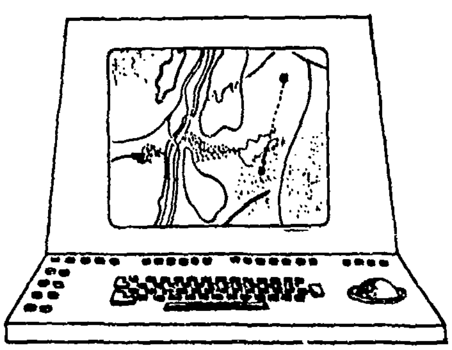
NOTE: Both stepping and piezoelectric joysticks are implemented only as relative positioning graphics interaction devices.

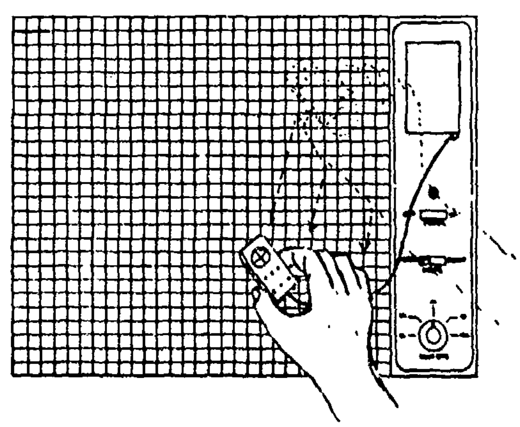
f. <u>Digitizing pad/tablet</u>. The user/operator places a digitizing device on the surface of a position-sensing grid. The positions on the grid are directly related to the positions on the display screen. By placing the digitizing device at a particular point on the grid, the user/operator can cause the screen cursor to move to the analogous position. The digitizing device may be a stylus.



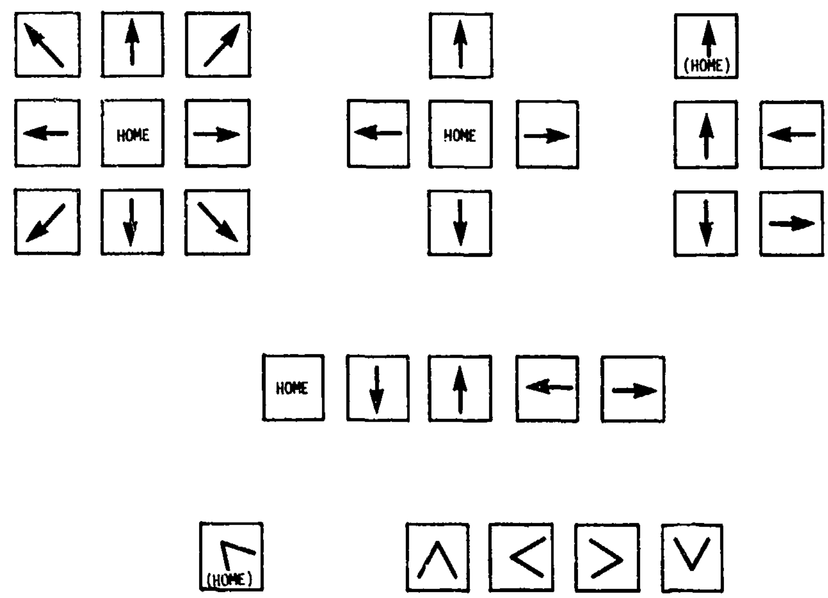


Or, the device may be a cross-hair digitizing cursor.

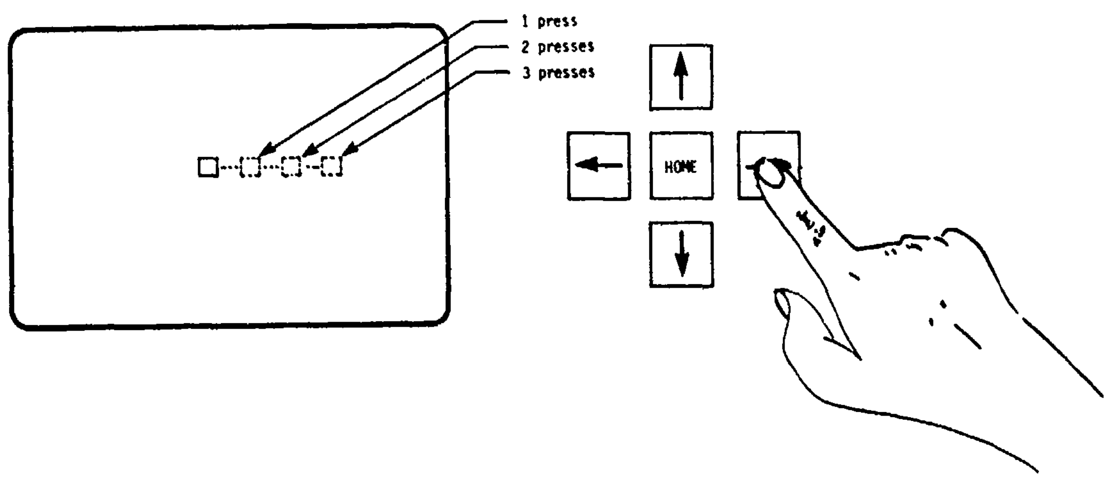




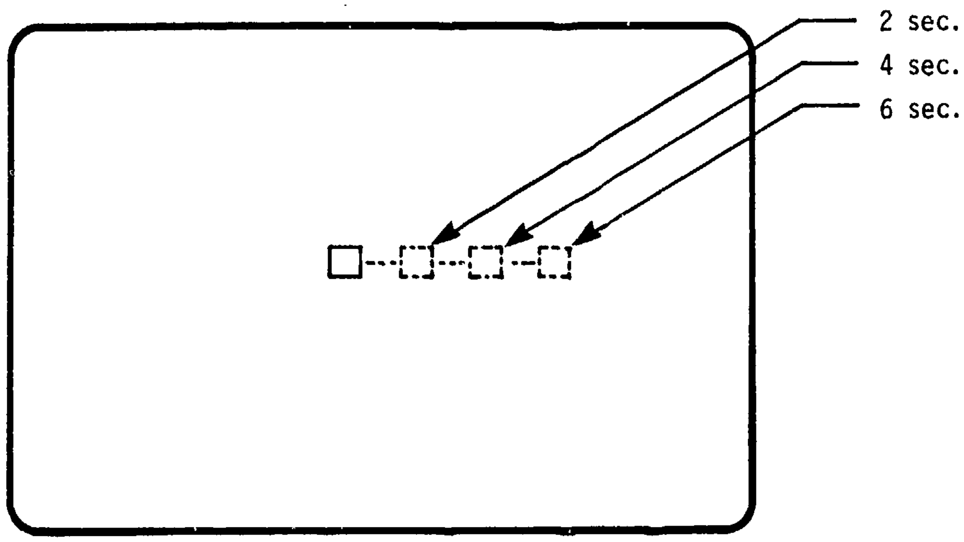
g. Cursor control keys. The user/operator controls the movement of the screen cursor by pressing fixed function keys labeled with the direction in which the cursor will move. Cursor control keypads may appear in a number of configurations:



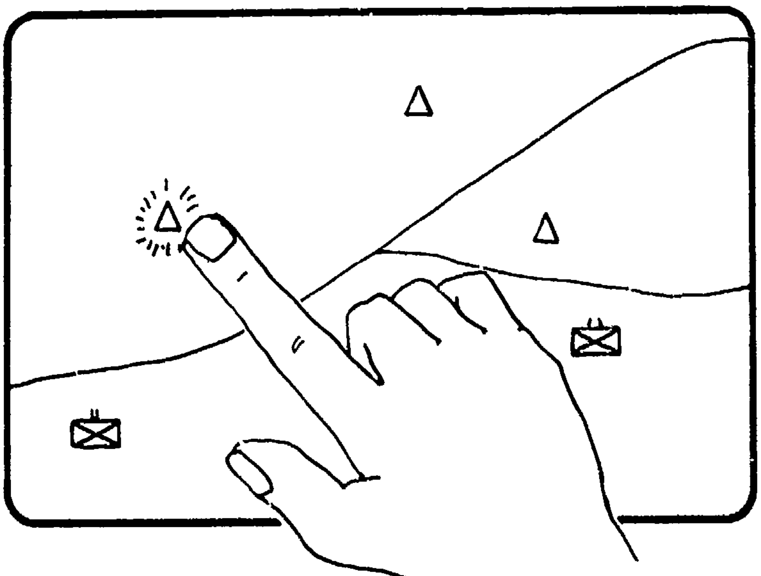
The screen cursor may move one increment in the indicated direction each time a cursor control key is pressed.



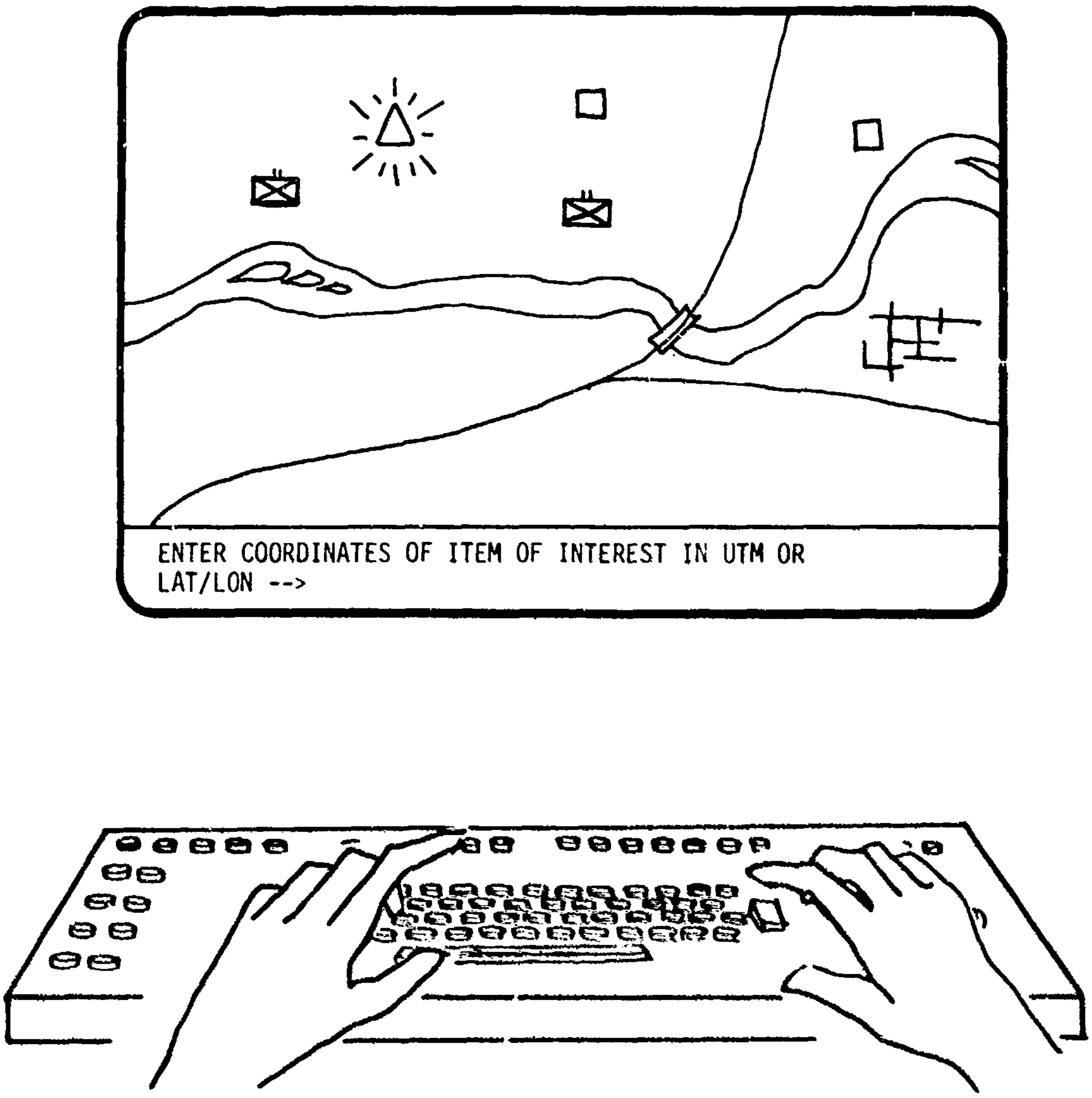
Or, the screen cursor may continue to move as long as the key is being pressed.



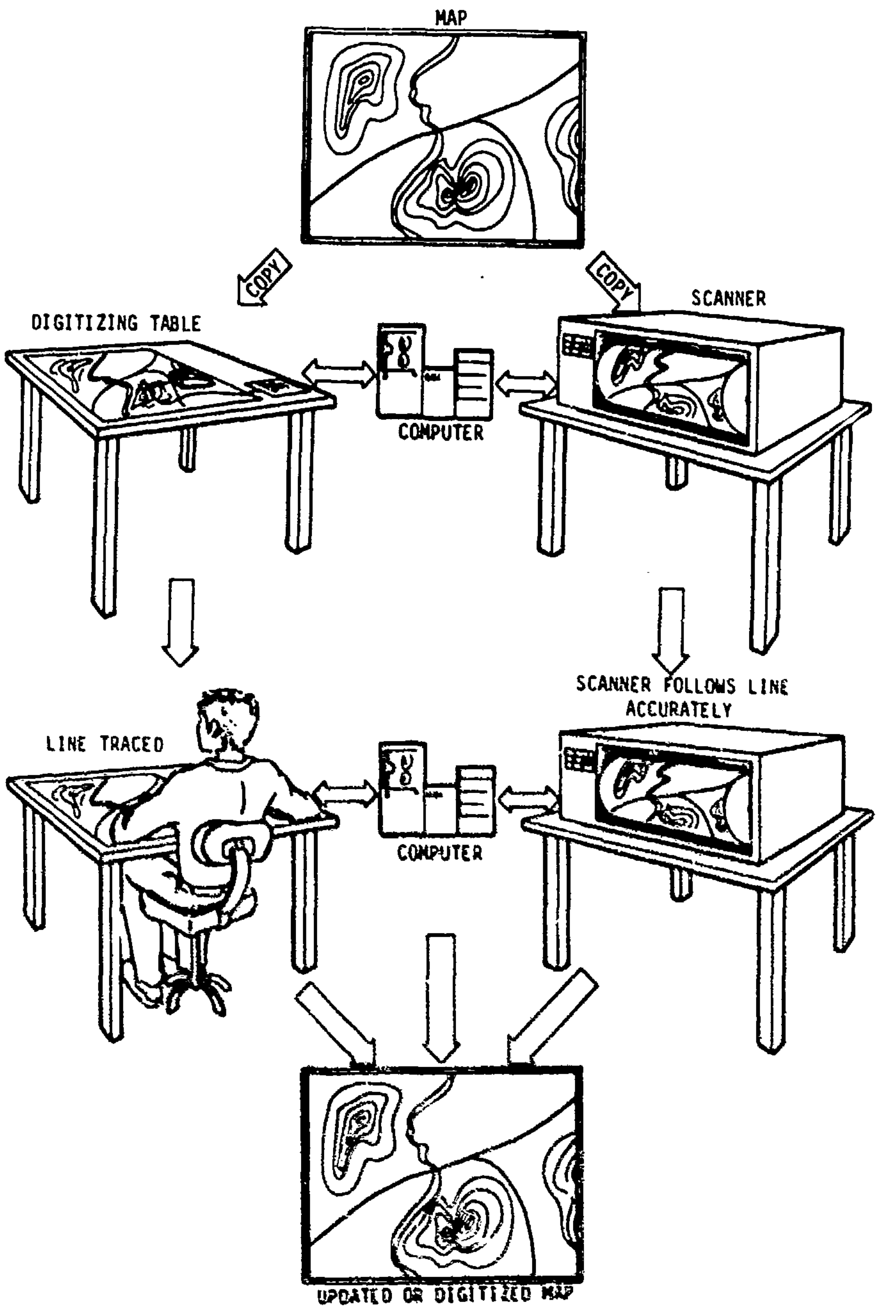
h. Touch sensitive display. The user/operator touches a finger to the display to control the activity of the screen cursor or to indicate a symbol. This method is very much like light pen/light gun interaction, except that it does not require the extra light pen hardware.



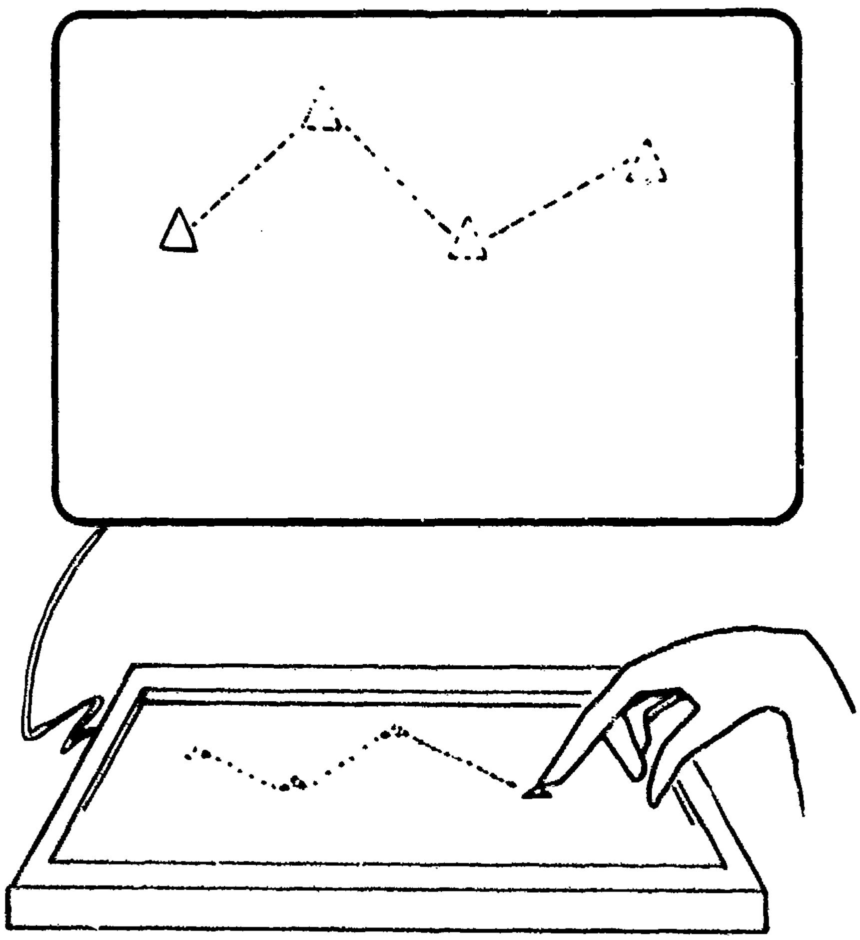
i. Keyboard coordinate entry. The user/operator types in the coordinates of the item/phenomenon with which he/she wishes to work.



j. Scanner/digitizer. In this type of interaction, the user/operator works with a digitizing pad, tablet, or table which is linked to a "flying spot scanner" (FSS). The FSS is registered to the same hard copy which is placed on the digitizing hardware. The scanner tracks the placement of the digitizing device, reducing the requirement for the user/operator to follow a line precisely.



k. Touch sensitive pad. The user/operator controls the movement of the screen cursor by moving a finger across the surface of a small, touch sensitive surface. The direction of movement of the screen cursor is controlled by the orientation of the finger with respect to the center of the touch sensitive surface. The speed of movement of the screen cursor is determined by the distance of the finger from the center of the surface.



1.2.5 RECOMMENDATIONS FOR GRAPHICS CONTROL METHODS

The selection of graphics control methods for a given system application is heavily dependent on the specific characteristics of the application. Table 1.2-1 suggests the application/method combinations which may, in a given set of circumstances, be optimal. To check on specific applications, refer to the recommendations in the remainder of this section presented for the applicable graphics control methods identified in the matrix.

Table 1.2-1. Methods of Graphics Control by Application Being Considered

		APPLICATION					
		SELECTING GRAPHIC COMMANDS	SKATCHING OR DRAWING LINES ON THE DISPLAY	FOLLOWING DETAILED LINES FROM HARD COPY	PLACING AND MOVING SYMBOLS ON THE DISPLAY	SELECTING DISPLAY PARAMETERS	ORIENTING SYMBOLS
METHOD	ALPHANUMERIC COMMAND ENTRY TECHNIQUES	•				•	•
	LIGHT PEN/LIGHT GUN	•	•		•	•	•
	MOUSE	•	•	•	•	•	•
	TRACKBALL	•	•		•	•	•
	JOYSTICK	•	•		•	•	•
	DIGITIZING PAD/TABLET/TABLE	•	•	•	•	•	•
	CURSOR CONTROL KEYS	•	•		•	•	•
	TOUCH SENSITIVE DISPLAY	•	•		•	•	•
	KEYBOARD COORDINATE ENTRY		•		•		•
	SCANNER/DIGITIZER			•			
	TOUCH SENSITIVE PAD	•	•		•	•	•

a. Selecting or specifying graphics commands. The appropriateness of particular graphics control methods for selecting or specifying graphics commands depends on at least the following factors:

1. The number of commands which are available for use by the user or operator. Some methods are very convenient when there are only a few commands required, but become unwieldy when there are large numbers of commands.

2. The availability of multiple screen displays, which can determine whether presentation of graphics command options will require that the "working" graphics display be replaced by a listing of the available command options.

3. The rate at which commands will be used in a typical application.

4. The complexity of commands, in terms of whether only the command is required, or whether a parameter or set of parameters must accompany the command.

Recommendations for using graphics control methods for selecting or specifying graphics commands are presented in Table 1.2-2.

Table 1.2-2. General Recommendations for Graphics Control Methods for Selecting and Specifying Graphic Commands

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR									
	NUMBER OF COMMANDS			DISPLAY AVAILABILITY		COMMAND RATE			COMMAND COMPLEXITY	
METHOD	HIGH (>30)	MEDIUM (10 - 30)	LOW (<10)	MULTIPLE SCREEN DISPLAY	SINGLE SCREEN DISPLAY	>5/MINUTE	1-5/MINUTE	<1/MINUTE	COMMAND ONLY	COMMAND AND PARAMETER
ALPHANUMERIC COMMAND ENTRY TECHNIQUES	1	1	1*	1*	2	1	1*	1*	2	1
LIGHT PEN/LIGHT GUN	3	3	2	2	1	3	2	1	1	2
MOUSE	3	2	2	2	1	2	2	1	1	3
TRACKBALL	3	2	2	2	1	2	2	1	1	3
JOYSTICK	3	2	2	1	1	1*	2	1	1*	3
DIGITIZING PAD/TABLET	2	2	1	2	1	1	1	1	1	2
CURSOR CONTROL KEYS	3	3	2	2	1	3	2	1	1	2
TOUCH SENSITIVE DISPLAY	4	3	2	2	1	3	2	1	1	4
TOUCH SENSITIVE PAD	4	2	2	2	1	2	2	1	1	4

*Recommended as 1st choice for standardization purposes.

b. Sketching or drawing lines on the display. The following factors affect the decision of what graphics control method to use for sketching or drawing lines on the graphics display:

1. The line placement accuracy, or how far any given line segment may deviate from the position desired or indicated by the user or operator.

2. The required drawing speed, or how fast the user should be able to draw the lines on the display.

Recommendations for using graphics control methods for sketching or drawing lines on the display are presented in Table 1.2-3.

Table 1.2-3. Recommendations for Using Graphics Control Methods for Sketching or Drawing Lines on the Display

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR						
	LINE/SYMBOL PLACEMENT ACCURACY				DRAWING SPEED		
METHOD	VERY HIGH (<.05")	HIGH (.05 - .15")	MEDIUM (.15 - .40")	LOW (>.40")	>10 INCHES/SEC	1 - 10 INCHES/SEC	<1 INCHES/SEC
LIGHT PEN/LIGHT GUN	4	3	2	1	1	1	1
MOUSE	4	4	3	1	2	1	1
TRACKBALL	3	3	2	1	[illegible]	2	1
JOYSTICK (DIRECT POSITIONING)	4	3	2	1	2	1	1
JOYSTICK (RELATIVE POSITIONING)	3	2	2	1	3	3	2
DIGITIZING PAD/TABLET	3	2	[illegible]	1*	1*	1*	1*
CURSOR CONTROL KEYS	2	2	[illegible]	2	4	4	3
TOUCH SENSITIVE DISPLAY	4	4	3	2	1	1	1
TOUCH SENSITIVE PAD	3	3	2	1	3	3	[illegible]

*Recommended as 1st choice for standardization purposes

c. Tracing detailed lines or points from hard copy. Selection of the best graphics control method for tracing detailed lines or points from hard copy materials requires consideration of the following factors:

1. The line/symbol placement accuracy required in the particular application.

2. The amount of clutter on the hard copy, i.e., the relative amount of undesired lines and symbols on the hard copy as compared to the number or amount of desired lines or symbols.

3. The type of digitization required. In general, stream digitization will be used when the user wishes to trace the route of some item from the hard copy display, e.g., river, road, railroad, political boundary. Point digitization will be used to indicate the position of figures and symbols on the hard copy.

Recommendations for using graphics control methods for tracing detailed lines or points from hard copy are presented in Table 1.2-4.

Table 1.2-4. Recommendations for Using Graphics Control Methods for Tracing Detailed Lines or Points from Hard Copy

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR									
	LINE/SYSTEM PLACEMENT ACCURACY				AMOUNT OF CLUTTER				TYPE OF DIGITIZATION	
METHOD	VERY HIGH (< .05")	HIGH (.05" - .15")	MEDIUM (.15" - .40")	LOW (> .40")	LARGE	MODERATE	LITTLE	NONE	POINT	STREAM
MOUSE	4	4	3	2	1*	1*	1	3	2	3
DIGITIZING TABLET/PAD/TABLE	3	2	1	1	1	1	2	3	1	2
SCANNER/DIGITIZER	1	1	1*	1*	3	3	2	1	2	1

*Recommended as 1st choice for standardization purposes.

d. Placing, moving, indicating, and deleting symbols. The considerations involved in placing, moving, indicating, and deleting symbols on a graphics display include:

1. Line/symbol placement accuracy requirements of the particular application.

2. The required speed for symbol manipulation.

3. The rationale for symbol placement, i.e., whether the final location of the symbol to be placed or moved is at the discretion of the user or operator, or whether its location has been or can be specified by the use of georeference coordinates.

Recommendations for using graphics control methods for placing, moving, indicating, and deleting symbols are presented in Table 1.2-5.

Table 1.2-5. Recommendations for Graphics Control Methods for Placing, Moving, Indicating, and Deleting Symbols from a Graphics Display

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR								
	ALLOWABLE POSITION DEVIATION				REQUIRED SPEED OF SYMBOL PLACEMENT/DELETION			METHOD OF PLACING/MOVING SYMBOLS	
METHOD	VERY HIGH (< .48")	HIGH (.15" to .40")	MEDIUM (.05" to .15")	LOW (< .05")	HIGH (<2 SEC.)	MEDIUM (2-5 SEC.)	LOW (>5 SEC.)	JUDGMENT/ESTIMATION	USE OF EXISTING COORDINATES
LIGHT PEN/LIGHT GUN	1*	2	3	4	1*	1*	1*	1*	3
MOUSE	1	1*	2	3	1	1	1	1	3
TRACKBALL	1	1	1*	1*	1	1	1	1	3
JOYSTICK (DIRECT POSITIONING)	1	2	3	4	1	1	1	1	3
JOYSTICK (RELATIVE POSITIONING)	1	1	1	1	1	1	1	1	3
DIGITIZING TABLET/PAD/TABLE	1	1	1	1	1	1	1	1	3
CURSOR CONTROL KEYS	1	1	1	1	2	1	1	1	3
TOUCH SENSITIVE DISPLAY	2	2	3	4	1	1	1	1	3
TOUCH SENSITIVE PAD	1	1	2	3	1	1	1	1	3
KEYBOARD COORDINATE ENTRY	1	1	1	1	3	2	1	3	1

*Recommended as 1st choice for standardization purposes.

e. Selecting display parameters. Selection of the best graphics control method for selecting display parameters involves consideration of at least the following factors:

1. The number of parameters which are available.

2. The availability of multiple-screen displays.

3. The rate at which parameters are to be selected.

Recommendations for using graphics control methods for selecting display parameters are presented in Table 1.2-6.

Table 1.2-6. Recommendations for Graphics Control Methods for Selecting Display Parameters

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR‡							
	NUMBER OF PARAMETERS IN SYSTEM			DISPLAY AVAILABILITY		COMMAND RATE		
METHOD	SMALL <10	MODERATE 10 - 49	LARGE >50	MULTIPLE SCREEN DISPLAY	SINGLE SCREEN DISPLAY	>5/MINUTE	1-5/MINUTE	<1/MINUTE
ALPHANUMERIC COMMAND ENTRY METHODS	1*	1	1	1*	2	1	1*	1*
LIGHT PEN/LIGHT GUN	2	3	4	2	1*	3	2	1
MOUSE	2	3	4	2	1	2	2	1
TRACKBALL	2	3	4	2	1	2	2	1
JOYSTICK	2	3	4	2	1	2	2	1
DIGITIZING PAD/TABLET/TABLE	1	2	4	1	1	1*	1	1
CURSOR CONTROL KEYS	2	3	4	2	1	3	2	1
TOUCH SENSITIVE DISPLAY	2	3	4	2	1	3	2	1
TOUCH SENSITIVE PAD	2	3	3	2	1	2	2	1

*Recommended as 1st choice for standardization purposes.

f. Orienting symbols. Selection of the best graphics control method for orienting symbols involves consideration of at least the following factors:

1. The rationale for deciding upon the orientation of the symbol.

2. The required rate of specifying orientations for symbols or other items.

3. The required accuracy of orientation.

Recommendations for using graphics control methods for symbol orientation are presented in Table 1.2-7.

Table 1.2-7. Recommendations for Graphics Control Methods for Orienting Symbols

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	DECISION FACTOR										
	METHOD OF SELECTING ORIENTATION				ORIENTATION RATE			REQUIRED ORIENTATION ACCURACY			
	ESTIMATION	ESTIMATION FROM POSITION OF OTHER DISPLACED ITEMS	DIRECT INPUT OF QUANTITATIVE ORIENTATION VALUE	DIRECT INPUT OF CATEGORICAL ORIENTATION VALUE (E.G., "NW")	HIGH > 5/MINUTE	MODERATE 1 - 5/MINUTE	LOW < 1/MINUTE	LOW < ± 15 DEGREES	MODERATE ± 15 DEGREES TO ± 5 DEGREES	HIGH ± 5 DEGREES TO ± 1 DEGREE	VERY HIGH > ± 1 DEGREE
ALPHANUMERIC COMMAND/ DATA ENTRY TECHNIQUES	3	3	1	2	1	1	1	1	1	1	1
LIGHT PEN/LIGHT GUN	1*	1*	3	1*	3	2	1*	1*	2	3	4
MOUSE	1	2	3	2	2	2	1	2	3	3	4
TRACKBALL	1	2	3	2	2	2	1	1	2	3	4
JOYSTICK	1	1	3	1	2	2	1	1	2	3	4
DIGITIZING PAD/ TABLET/TABLE	1	2	3	2	2	2	1	1	2	3	4
CURSOR CONTROL KEYS	3	2	3	2	2	2	1	2	3	3	4
TOUCH SENSITIVE DISPLAY	1	2	3	2	3	2	1	1	2	3	4
TOUCH SENSITIVE PAD	2	2	3	2	2	2	1	1	2	3	4

*Recommended as 1st choice for standardization purposes.

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1.3 HELPs

1.3.1 DEFINITION

HELP features are those which assist the user in determining what the system is capable of doing, or what user actions and inputs are required to perform a desired function, or the meaning of displays and messages produced by the system.

1.3.2 APPLICATIONS FOR HELP FEATURES

HELP features can be used to assist users/operators in virtually all aspects of computer system operation. Some of the more important applications of HELP features include:

a. Assistance in controlling the operations of the system. Here, HELP features may be used to:

   1. Inform users/operators about the capabilities of the system, in terms of what the system can and cannot do.

   2. Indicate to users/operators what commands or actions are required to cause the system to perform a desired operation.

   3. Indicate the correct format for commands.

   4. Indicate what options are available for specific commands, and how the user is to select those options.

b. Assistance in interpreting the output of the system, by helping to:

   1. Explain to the user the format and content of displays used in the system outputs.

   2. Explain abbreviations and contractions used in the displays to conserve valuable display space.

   3. Indicate the circumstances under which particular displays or portions of displays will be produced by the system.

c. Assistance in entry of data into the system, by helping to:

   1. Indicate to the user the correct form and content of information to be entered into the system.

   2. Indicate to the user options in the way information can or should be entered into the system.

   3. Explain the methods for getting information into the system, and under what circumstances these methods should be used.

   4. Provide lists of legal terms to be used in data entry.

   5. Provide indications of the legal values associated with particular data items.

d. Assistance in querying data bases, by helping to:

   1. Explain the kinds of queries which can be performed on the data base.

2. Explain the proper format for queries to be entered in the system.

3. Indicate how options in data base query are to be formed and entered into the system.

4. Explain how to store, retrieve, and modify standing or stored queries to avoid reentering complex data retrieval requests.

e. Assistance in message generation, by helping to:

1. Indicate what kinds of messages may be created using the system.

2. Explain the way in which messages are created.

3. Explain the meaning of specific commands used in the creation of messages.

4. Explain procedures for avoiding unnecessary system interaction when filling out sparsely filled messages.

f. Assistance in error handling, by helping to:

1. Explain the conditions under which errors will be detected and those under which errors will not be detected.

2. Indicate the kinds of error detection performed by the system.

3. Provide detailed information on the meaning of error messages generated by the system.

4. Suggest in detail the potential causes of errors about which the user has been notified.

5. Explain procedures used to correct errors.

1.3.3 BENEFITS OF HELP FEATURES

Use of appropriate HELP features will make it easier for system users, particularly inexperienced ones, to determine how to use the system to best advantage. Good HELP feature design will enhance overall system performance by:

a. Reducing error rates, by minimizing:

   1. Errors due to the lack of specific information on particular commands, data entry strings, etc.

   2. Errors resulting from a lack of convenient methods for checking the legality of command, data, and query inputs.

b. Increasing system throughput rates, by minimizing:

   1. Time required to locate information dealing with a particular aspect of system operation.

   2. Time required to hunt through irrelevant guidance to locate desired assistance information.

   3. Time spent in consulting with more experienced users because appropriate assistance information was not available on-line.

   4. Time required to locate paper reference material which may have been mislaid or damaged.

1.3.4 METHODS FOR IMPLEMENTING HELP FEATURES

The implementation of HELP features involves consideration of at least six aspects of HELP methods. These are: the method for accessing the HELP feature; the effect of accessing the HELP feature; the structure of the HELP files or information provided to the user; the way in which HELP information is presented to the user; the specificity of HELP information presented to the user; and the nature of transfer of control or data entry information from the HELP feature to system operation or control. These six issues are discussed in more detail below.

a. Method for accessing HELP. There are several methods commonly employed to permit the system user to indicate that he/she wishes to review HELP information. These include:

   1. HELP key. Here, the user presses a key marked HELP to indicate a desire to review HELP information. The key may be a fixed function key or a programmable function key.

   2. HELP symbol. Here, the user enters a symbol to indicate a desire to receive HELP information. The most commonly used symbol is a question mark (?).

   3. HELP command string. In this method the user types in a command to indicate a desire to review HELP information. The most commonly used string is "HELP."

   4. Reference to a manual or other hard copy job aid. Here, the user has no access to on-line HELP information, or the information which is provided is so sketchy that it must be supplemented via a paper document. In this method, the user is provided with what is essentially a user's manual, although it may be structured so as to provide a more convenient reference in those situations when HELP information would ordinarily be requested from the system.

b. Effect of accessing HELP information. The issue here is what happens when the user requests access to HELP information. There are several methods of dealing with user requests for HELP information, including:

   1. Single-thread or unitary HELP, in which the user or operator receives the same information no matter under what conditions the HELP information is requested. For example, if a system employs a HELP key, the same HELP information would be presented to the user no matter what system-related operations were being performed when the key was pressed.

2. Situation-dependent HELP. In this method, the system would vary its presentation of HELP information depending on the kind of activity being performed when the HELP feature was engaged. For example, if the user were in the process of performing a query, the system would respond with information about performing a query. If the user were faced with a prompt requesting a command, the system would respond with information about the available commands or with information about the format of the commands which were legal at that point in system processing.

3. User-selectable situation dependence for HELP feature. Here, the user specifies whether the HELP information to be presented should be situation-dependent or not.

4. Menu-selectable HELP subfunction. In this method, requesting the HELP function results in the display of a HELP menu, from which the user may request the specific information which he/she desires. In general, the menu is tailored to the specific process which the user is performing, but menu options to access HELP information unrelated to that process are also provided.

c. HELP information structure. Methods here deal with how the HELP information to be provided to the user is organized. Options in HELP information structure include:

1. Linear HELP structure, in which all of the information on a given topic is presented in sequential, linear fashion, much as it might be in a chapter of a book or users' manual.

2. Hierarchical HELP structure, in which the HELP information is configured in a hierarchical set, so that users can iteratively specify in increasing detail their specific HELP information needs. The structure may be either situation-dependent or situation-independent.

3. Multi-level hierarchical HELP structure. In this method the entry points in the hierarchy are at various levels, rather than being only at the top of the hierarchy. In other words, the HELP system structure attempts to estimate the level of detail of information needed by the user on the basis of what activities are being performed, and to provide the user with information at appropriate levels of informational specificity.

4. Reference to HELP manual. In this method, the only practical way of obtaining information about system capabilities is to look it up in a hard-copy reference manual. The online HELP capability is nonexistent or extremely limited.

d. HELP data presentation. There are at least five methods for presenting HELP information to the user:

1. Replace current display, in which the HELP information either "overwrites" the working display or is tacked onto the end of the current display. This method of presenting HELP information can, and usually does, destroy at least part of the display on which the user was working before HELP was requested.

2. Reserved HELP screen area, in which HELP messages appear in an area of the screen which is set aside for HELP information only. This screen area will therefore be blank unless HELP data has been requested. This method has the disadvantage of reducing the amount of screen space for both the HELP information and other information which is to be displayed on the screen.

3. Separate HELP display screen. In this method, the HELP information is displayed on a screen completely separate from the one which contains the displays with which the user is working when the HELP data are requested. Generally, the two screens are placed in close proximity to each other to increase the ease with which HELP information may be compared to the contents of the working display.

4. Hard copy of HELP displays. In this method, HELP information, whether it is currently being displayed on the CRT or has been requested, may be printed out at a hard-copy station.

5. HELP manuals. Here, the HELP information available to the user has been previously extracted from the system, organized in some fashion, and placed into a HELP manual. The user must decide, assisted by the structure of and any index(es) to the manual, what portions of the manual to reference to obtain the required data.

e. HELP information specificity. Different users, as well as different operating conditions and situations, may require different levels of specificity in the amount of information presented to the user when a HELP information is presented. Three methods for dealing with the specificity of HELP information are:

1. Single-specificity HELP, in which the information contained in response to a request for HELP information is always at the same level of specificity.

2. Variable, user-selectable HELP specificity, in which the HELP feature includes two or more levels of specificity of information which may be displayed to the user. For example, in a ground order-of-battle system, the user may be interested in knowing what the code "T87a" means. If the "brief" or "concise" HELP mode has been selected, the following HELP message might be provided:

T87a---SOV. MAIN BTTL. TNK.

If the "full" or "complete" mode were selected, the HELP message would be considerably more detailed, and might appear like the following:

> "T87a--SOVIET MAIN BATTLE TANK. <u>STANDARD EQUIPMENT</u>: 133 MM GUN; 34 RNDS. HEAT; 15 RNDS. HE; 5 RNDS. SMOKE; LASER RANGEFINDER; RADAR DETECTOR FOR X-BAND; SNORKEL (12 FT. STREAM TRAVERSE). <u>OPTIONAL EQUIPMENT</u>: TUBE FIRED 'TALON IV' LWIR SEEKER MISSILE (12 KM. RANGE); 'RAZOR' RPV RECON (LWIR, VISUAL, ACOUSTIC, MAGNETIC DETECTION.)"

3. <u>Pointers to HELP manual sections</u>: In this method, the HELP information display either consists of or includes a reference to the user or HELP manual section in which the user can find more information on the issue of interest. Such pointers may either replace or supplement existing HELP messages provided on-line.

f. <u>HELP information transfer</u>. Once the user/operator has located the desired information in a HELP display, there remains the problem of how to use that information in performing the activity about which the user had questions in the first place. There are at least three methods of transferring the information back to the data or command entry display from which the HELP display was called:

1. <u>Return only</u>. In this method, the user reviews the HELP information and then commands the system to return to operational, rather than HELP, mode. The user must remember the HELP information (or obtain a hard copy of it for reference) in order to use it appropriately.

2. <u>Single-parameter HELP</u>. In this method, the user may select while in HELP mode an option from a menu list, or may formulate a command based on the information contained in the HELP display. This information is then automatically passed back to the operational program, where it is treated exactly as though the user had entered the command in response to the command or data entry prompt in the operational program.

3. <u>HELP command construction capability</u>. This mode is similar to the one discussed just previously, except that the user has the option to select a whole series of commands or data entries while viewing the HELP information. This method permits the user to address complex command or data entry issues while reviewing the HELP files themselves, rather than trying to remember command/data entry formats and contents after having returned to an operational display.

1.3.5 RECOMMENDATIONS FOR HELP FUNCTIONS

Selection of HELP function methods depends on the nature of the system being developed and the characteristics of the users/operators of the system. Some of the most important factors involved in making these decisions include:

a. Sophistication and experience of the users/operators.

1. HIGH level of sophistication means that the users/operators are very familiar with the system, its capabilities, and the types and sequences of operations and data entries with which the system will deal. Users/operators with a HIGH level of sophistication will have (a) received a substantial amount of training in system operation and data entry or (b) had considerable experience in operating the system by the time they are called upon to use it in operational situations, or (c) both of the above.

2. MEDIUM level of sophistication means that users/operators are quite familiar with most of the important capabilities, commands, data entries, display formats, etc., associated with system operation, but are not intimately familiar with little-used features of the system. Users/operators with a MEDIUM level of sophistication may have received considerable training, but will not have used the system enough to maintain their knowledge about all of the capabilities of the system.

3. LOW level of sophistication means that users/operators are familiar with only the "big picture" of system operation. They may be familiar with some of its features and capabilities, but not all or even the most important ones.

4. VARIABLE level of sophistication means that different users/operators have different levels of experience and capability in using the system. Some may be very familiar with its features and capabilities, while others will be aware of only the most elementary or important features.

b. Number of commands.

1. HIGH--more than 600 separate commands, command options, data entry elements, and query items.

2. MEDIUM--201 to 600 separate commands, command options, data entry types, and query items.

3. LOW--1 to 200 separate commands, command options, data entry types, and query items.

c. Computer-to-terminal data transmission rate.

1. HIGH--4800 baud (480 characters per second) or greater.

2. MEDIUM--1200 baud (120 characters per second) or greater, but less than 4800 baud (480 characters per second).

3. LOW--less than 1200 baud (120 characters per second).

d. Complexity of system.

1. HIGH--more than 50 separate functions performable by the system, with numerous subfunctions associated with each function.

2. MEDIUM--11 to 50 separate functions performable using the system, with numerous subfunctions associated with each function.

3. LOW--10 or fewer separate functions performable using the system.

e. Storage available

1. HIGH--there is sufficient storage to provide high-speed access on-line to essentially all information which even the most unsophisticated user would need to perform required interactive operations using the system.

2. LOW--there is insufficient storage to provide full HELP information on-line.

Recommendations for the use of specific HELP functions methods are presented in Table 1.3-1.

Table 1.3-1. Recommendations for the Use of Specific HELP Functions and Methods

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

HELP FUNCTIONS IN CONTROL METHODS		DECISION FACTOR: EXPERIENCE OF USERS				DATA TRANSFER RATE			NUMBER OF COMMANDS/ DATA INPUTS			COMPLEXITY OF SYSTEM			STORAGE AVAILABLE	
		HIGH	MEDIUM	LOW	VARIABLE	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW	HIGH	MEDIUM	LOW	HIGH	LOW
METHOD FOR ACCESSING "HELP"	HELP Key	1*	1	1	1	1*	1*	1*	1	1	1	1	1	1	1	1
	HELP Symbol	1	2	3	2	1	1	1	2	2	2	2	2	2	2	2
	HELP Command String	2	3	4	3	1	1	1	3	3	2	3	3	2	3	3
	Lookup in manual or other hard copy reference	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
EFFECT OF ACCESSING HELP	Single-thread HELP	3	3	3	3	1	1	1	3	2	1	3	2	1	1	1
	Situation-dependent HELP	2	2	2	2	1	1	1	2	2	1	2	2	1	1	1
	User-selectable situation dependence for HELP	1*	1*	2	1	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*
	Menu-selectable HELP subfunction	1	1	1	2	1	2	3	1	1	1	1	1	1	1	1
HELP INFORMATION STRUCTURE	Linear HELP Stucture	3	3	3	3	3	3	3	3	2	1	3	3	2	3	2
	Hierarchical HELP Structure	2	2	2	2	2	2	2	2	1	2	2	2	1	2	3
	Multi-valued hierarchical HELP structure	1	1	1	1	2	2	2	1	2	3	1	1	2	1	3
	Reference to HELP Manual	3	3	3	3	3	3	2	2	2	3	2	2	3	3	2
HELP DATA PRESENTATION	Current display replace	2	2	3	3	2	2	3	4	4	4	4	4	4	4	4
	Reserve HELP screen area	3	3	2	2	2	2	2	4	4	4	4	4	4	4	4
	Separate-screen HELP	1*	1*	1*	1*	1*	1*	2	4	4	4	4	4	4	4	4
	Hard copy of HELP	1	1	1	1	1	1	2	4	4	4	4	4	4	4	4
	HELP Manuals	1	1	1	1	3	3	2	4	4	4	4	4	4	4	4
HELP INFORMATION SPECIFICITY	Single-specificity HELP	2	2	2	2	2	2	2	4	4	4	4	4	4	3	2
	User-selectable HELP specificity	1	2	3	3	1*	1*	1*	4	4	4	4	4	4	1	2
	Pointers to HELP manual sections	2	2	2	2	1	1	1	4	4	4	4	4	4	3	2
HELP INFORMATION TRANSFER	Return only	2	2	2	2	2	2	2	3	3	2	3	3	2	4	4
	Single-parameter HELP	2	2	1	1	2	2	2	2	2	1	2	2	1	4	4
	HELP command construction capability	1	1	2	2	1	1	1	1	1	2	1	1	2	4	4

* Recommended as 1st choice for standardization purposes.

1.3.6 ADVISORY COMMENTS FOR HELP FUNCTIONS

a. Method for accessing HELP

1. If use of a HELP symbol is contemplated, the question mark is the preferred symbol.

2. If use of a HELP command string is contemplated, the word "HELP" is the preferred command.

3. Always provide the user/operator with a user's manual or other reference manual which essentially duplicates the contents of on-line HELP information, even if complete HELP information is provided on-line.

4. Provide an exhaustive index to all hard-copy HELP information.

5. Always provide a method for obtaining assistance on specific commands, data entry items, query items, etc. This method should be implemented as follows:

   (a) HELP key--(command or other item for which HELP is desired) + (press HELP KEY) = desired HELP display.

   (b) HELP character--(command or other item for which HELP is desired) + (HELP symbol) = desired HELP display.

   (c) HELP string--(HELP string) + (command or other item for which HELP is desired) = desired HELP display.

6. If system users have had extensive training or experience in the use of other systems which use a particular method for accessing HELP, provide that method in addition to the one most appropriate for the system being designed or modified.

7. Affix a printed label or sign to the terminal indicating to the user how to obtain HELP and use the HELP functions of the system.

b. Effect of accessing HELP

1. Use single-thread HELP with systems which are so simple that all of the information which a user might need to know about the system can be placed on a single display.

2. Provide a method for overriding automatic situation-dependent selection of HELP displays.

3. When a situation-dependent HELP display feature is being used, always provide a method for the user to escape from the HELP display which is presented and to access information about system functions other than the one which is being used currently.

c. HELP information structure

Use a linear HELP structure only when the system is so simple that the information required to HELP the user through any conceivable situation can be presented in four or fewer HELP displays.

d. HELP data presentation

1. When using current display replacement, arrange for display of HELP information such that as little of the working display is erased as possible. That is, do not gratuitously erase the entire contents of a working display simply to present a four-line HELP message.

2. When using a reserved area for HELP displays, provide a capability to (a) replace the working display with more detailed HELP information, (b) produce a hard copy of the more detailed information, or (c) reference pages in a paper reference manual which provide the more detailed HELP information, or (d) use some combination of the above.

3. When using current display replacement, returning from the HELP display to the operational display should present the user with exactly the same situation as existed prior to requesting the HELP information--except in the case where responses to the working display can be entered while viewing the HELP display. In the first instance, the response must still be entered; in the second instance, it has already been entered.

e. HELP information specificity

No advisory comments.

f. HELP information transfer

No advisory comments.

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SECTION 2. DISPLAY TECHNIQUES

Guidelines in this category specify methods for information presentation which contribute to user/operator accuracy and efficiency in information presentation and utilization. Speed, ease, and accuracy of comprehension are important factors here. Display techniques are considered within the following three categories:

1. Alphanumeric Displays describes conditions and techniques appropriate to generation of displays for alphanumeric data presentation.

2. Graphics Displays describes conditions under which pictorial and diagrammatic presentation of information are appropriate and delineate techniques for achieving optimum presentation.

3. Selective Highlighting describes techniques for differentiating displayed items which are of special interest to the user/operator from those which are more routine.

Some display formats are better suited to specific use conditions than others. Table 2-1 summarizes some of these use and display format relationships.

Table 2-1. Display Techniques by Application

KEY:

1 - APPROPRIATE

2 - ACCEPTABLE

3 - INAPPROPRIATE

DISPLAY TECHNIQUE	APPLICATION					
	Fixed or Free Text Report	Statis-tical Report	Trend Data	Pictorial/Symbolic Presen-tation	HELPs	Error Messages
Alphanumeric	1	1	4	4	1	1
Graphic	4	2	1	1	2	4

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2.1 Alphanumeric Displays

2.1.1 DEFINITION

Alphanumeric displays are screen or hard-copy presentations of information composed of the alphanumeric symbol sets. (See the discussion of symbols and symbol sets in Section 6.1.) To the extent that grammatical symbols are required for textual separation, or that special symbols associated with a specific area of science or technology are required, fixed alphanumeric displays also contain these additional symbols and symbol sets.

2.1.2 APPLICATIONS FOR ALPHANUMERIC DISPLAYS

Alphanumeric displays are appropriate for:

a. Presentation of layouts for data entry.

EXAMPLE: In a field artillery system, all information is entered within a selected prestructured message format. The format consists of data field labels, data field delimiters (made up of grammatical symbols), and spaces for data element entry. All entries are alphanumeric codes. Data entry length can not exceed the space allowed, and only proper information (legal entries) can be entered within a given data field.

b. Display of data for information or action purposes.

EXAMPLE: A user/operator calls up a report on the number and status of heavy tanks for an armored division of a potential aggressor. After reviewing the report, the user/operator cancels the display.

EXAMPLE: In a field medical unit, the user/operator calls up the most recent medical supplies requisition. Due to recent unexpected adverse battle outcomes, the user/operator modifies the requisition to reflect medical supply needs for dealing with casualties and the report status is changed from "routine" to "emergency."

c. Display of a list of performance or other options (menu).

EXAMPLE: A tactical intelligence data handling system functions, in part, through user/operator call-up of preformatted displays and, in part, through the use of menus. Once the user/operator logs onto the system, a list of the machine's functions--a master menu--is automatically presented on the screen. Selection of a function from the master menu results, in some instances, in presentation of preformatted displays through which the user/operator constructs command statements to perform functions available in that mode of operation.

d. Presentation of HELPs to aid the user/operator.

EXAMPLE: One of the master menu options in the preceding example is a "HELP" option. Selection of the HELP option brings up the HELP display which provides brief definitions and descriptions of the coded options listed on the master menu.

e. Presentation of error feedback and error correction information.

2.1.3 BENEFITS OF ALPHANUMERIC DISPLAYS

Proper utilization of alphanumeric displays will enhance overall system performance through improved user/operator performance by:

a. Reducing error rates, by minimizing:

1. The necessity for recalling information from memory due to insufficient display of essential information.

2. Suboptimum display formats which make discriminations between separate items of information difficult.

3. Improper retrieval of essential information due to inappropriate mode and/or features of information presentation.

4. Difficulty in distinguishing among logical subelements of a data item which is required for subsequent command or data item entry.

b. Increasing system throughput rates, by minimizing:

1. Difficulty in locating information displayed on the screen.

2. Time required to identify and correct errors.

3. Efficiency of the data organization for data entry and retrieval.

4. Requirement to postpone operation due to delay in obtaining requisite information.

2.1.4 METHODS FOR ALPHANUMERIC DISPLAYS

Alphanumeric displays are of two basic types: fixed and variable.

a. Fixed alphanumeric displays. Fixed alphanumeric displays cannot be varied by the user/operator in shape, size, or data element label. Fixed alphanumeric displays can be provided through the following methods:

1. Lists of appropriate information. These lists can take any of a variety of forms.

(a) Lists may be in the form of legal codes as follows, for example, for ammunition type:

AMMUNITION TYPE	NUMBER CODE	LETTER CODE
Armor piercing	1	ARM
Biological	2	BIO
Fragmentation	3	FRA
Gas/Chemical	4	GAS
Illumination (Flare)	5	ILL
Incendiary	6	INC
Nuclear	7	NUC
Smoke	8	SMO

(b) Lists may be in the form of code definitions, as follows, for ammunition type codes:

LETTER CODE	NUMBER CODE	AMMUNITION TYPE
ARM	1	Armor piercing
BIO	2	Biological
FRA	3	Fragmentation
GAS	4	Gas/Chemical
ILL	5	Illumination (Flare)
INC	6	Incendiary
NUC	7	Nuclear
SMO	8	Smoke

(c) Lists may be in the form of a menu which presents options, as shown below for selection of ammunition types:

```
AVAILABLE AMMUNITION TYPES ARE:

   1. ARM --- ARMOR PIERCING
   2. BIO --- BIOLOGICAL
   3. FRA --- FRAGMENTATION
   4. GAS --- GAS/CHEMICAL
   5. ILL --- ILLUMINATION (FLARE)
   6. INC --- INCENDIARY
   7. NUC --- NUCLEAR
   8. SMO --- SMOKE

ENTER THE # OR LETTER CODE FOR DESIRED AMMUNITION TYPE, OR ENTER
ONLY A CARRIAGE RETURN TO GET BACK -->
```

2. Prestructured formats.

(a) Prestructured formats are used for "registered" entry of data. A prestructured format for data entry is made up of a data field label and space for data element entry. These formats are a version of "fill-in-the-blanks" which basically look like:

```
WSTR:__;AZ:____;DF:____;
FZ:____/____;
```

or:

```
FZES:____/____,____/____,____/____,____/____,____/____,____/____;
```

Usually, a variety of information types is required to complete a prestructured format. For example, the PLOT CONTROL DATA format shown below requires identifier data (PLOT ID:, SCTY MARK:, TITLE:), addressee data (NAME OF FILE TO RECEIVE THIS DATA:), as well as detailed parameters of the plot (LOWER LEFT GEO:, PROJECTION:, SPHEROID:, STANDARD PARALLELS:, LAT INC:, LONG INC:, etc.).

```
                         PLOT CONTROL DATA

NAME OF FILE TO RECEIVE THIS DATA: ______________________
PLOT ID:______   SCTY MARK: _____   TITLE:______________

LOWER LEFT GEO:____  SPHEROID: __    UPPER RIGHT GEO:__
PROJECTION:___                       MAP SCALE: ____ MAP SHEET:____
STANDARD PARALLELS:_______           REF. LONG: ____ GRID TYPE:____
LAT INC.:______  LONG INC.:____       UTM INC.:____

MARGINS:  TOP: ___ BOTTOM: ____      LEFT:___  RIGHT: ___

LETTER SCALE:____ SYMBOL SCALE: __   PLOT COLOR:__    PRIORITY: __
RESOLUTION:_____  OVERWRITE:___

MEASUREMENT OVERRIDE:
LOWER LEFT:  X:_____ Y: _____    LAT:_____      LONG:_____
UPPER RIGHT: X:_____ Y: _____    LAT:_____      LONG:_____
```

As in the previous examples (for FZ: and FZES:), the number of alphanumeric characters which may be entered is limited to the number of blanks following the data field label:

PROJECTION:___ SPHEROID: __

Different conditions can be imposed with respect to the requirement for filling in the blanks following the data field label. Under some circumstances (as determined during system design) there may be a requirement to fill in all the blanks. Or, some systems may permit codes of varied length for a given data field, thereby sometimes permitting the nonuse of alphanumeric character blanks.

Prestructured formats can also vary the requirement for use or nonuse, i.e., the conditions of use of a complete data field, as follows:

- (R) Required entry.
- (S) Entry of one or more of a multiple set of fields.
- (C) Conditional entry--completion of one data element requires completion of another.
- (O) Optional entry.
- (N) Do NOT enter data.
- (A) or (B) Entry of at least one set of data required in a multiple set field.

The two following formats demonstrate use of the above conditional data entry requirements. These codes--shown shaded in the formats--are not part of the data entry. The codes can be presented off-line in documentation Or, if presented on-line, they are overridden by data entry or otherwise deleted so that they do not interfere with data entered into the format.

```
______;P:_;SB:_/_/_/__/___;C:SRD;SG:__,__;DT:__,__/__/__;ID:___;A:_;
SPRT;WPFL;WEAP ____/______/______;APPL /__;TRAVLR:__/___;
MAXRTE:._'SUSRTE:._;SHL:_;FZE:__;HE CHEM NUC
MAX:___;MIN:___;RAD:__;MYIELD:__/___/____;DELETE
PROB:_/___/___/___;RANGE ____;
```

Conditions: R=Required Entry; S=One of these must be entered; A=One of set A must be entered; B=One of set B must be entered; C=Conditional entry; O=Optional entry; N=Do not enter

```
______;P:_;SB:_/_/_/__/___;C:UN_;SG:__,__;DT:__,__/__/__;ID:___;A:_,
SPRT;COMD;PLAN:____;NAME:____;ABORT:S;NUCD
EDIT PRINT:;VIEW SHOW DELETE XMIT TO _/_/__/___;
ZON FRLT AIR FCA FCL NFL OSA FSCL CHA DAA MAPMOD
CHECK WPDF WEAP:____/______/______;
```

Conditions: R=Required Entry; S=One of these must be entered; A=One of set A must be entered; B=One of set B must be entered; C=Conditional entry; O=Optional entry; N=Do not enter

(b) Prestructured formats are also used for alphanumeric data output. In this usage they are standard reports whose basic structure does not alter no matter what the extent of data available or requested. They are formulated on the basis of information already available in the "machine." Prestructured formats can be very small or very lengthy, as shown below. In some instances they produce multiple pages and/or multiple screens of output.

```
ACK 2 ;P:2;SB:F/S/O/2 /BDE;C:UN ;SG: 7, 7;DT:09,17/51/02;ID:   491A: ;
FM:MTO:TGT:AF0020;KNPT:  ;AUG: / / /  /   ;VOL: 6;UNITS: 3;FPF: ;
SHAJ:     ;FZE:     ;SHEF:HEA2/HEA1;FZ:PDA /PDA ;ME:    ;   ;
CONT:WR  /FFE ;TOF:27.9;ANGLET:    ;PER:    ;M'S: J
```

A TACFIRE fire mission (FM) output message to observer (MTO) generated by the request for additional fire (FM:RFAF) input message.

```
FM;5201;        :ETO
FM RECOMMENDATION
TGT:AY0213;FROM:A/C/C/ /    ;DTG:**/ 0/20;

    F ;P:2;SB:A/C/C/  /   ;C:ETO;SG: 1, 2;DT:00,00/20/24;ID:  41;A: ;
FM;RFAF: ;MYEFF:  ;TGT:AY0213;CORD: 49400/   34500/  310;GZ:  ;
SPHERE: ;DIR:    /  ;TYPE:       /       ;DOP:       ;SIZE:    /   ;
ATT:     ;STR:    ;RV:   ;SH:   /    ;FZ:    /    ;DTG:  /  /  ;TOT:  /  ;
UFFES: / / /  /   ; / / /  /    , / / /  /    , / / /  /     , / / /  /  ;
CONT:    /    ;EFF:  ;VOL:   ;EOM: ;OPT:  ;MIS: ;PRI:  ;ATII: ;
OB:  ;DD: /    .    ;PTM:                 ∃

ATI DATA:
TGT:DY7012;CORD:549500/ 3834600/  360;GZ: 14;SPHERE:1;
          TYPE:WPN   /HVMG  ;DOP:        ;SIZE:  15/    ;ATT:    ;
          STR:   2;RV:  5;VEGTAT:      ;PERMNC:     ;MASKTI:15S;CLOTHE: ;
          DTG:29/ 3/46;PT:
```

```
MISSION DATA:
TGT.AY0213;CORD:549400/ 3834500/  310;GZ: 14;SPHERE:1;
          TYPE:PERS  /UNK   ;DOP:PRUG  ;SIZE: 100/     ;ATT:    ;
          STR:    ;PV:100;VEGTAT:      ;PERMNC:     ;MASKTI:   ;CLOTHE: ;
          ZONES:5DIV  ;2NBDE ,121NF ,
DISTANCE BETWEEN MISSION AND ATI TGT  141 METERS
NUMBER OF TGTS WITHIN 1 KM    3
TGT:AY0213; IN FCA:BENNIE;COORDINATE WITH FCORD:FS02DBDE  ;
FU: / /C/1 /41 ;TGTBEYOND MAX RANGE
TGT:AY0213;OUT OF TRANVERSE OF FU: / /C/5 /16 ;
TGT:AY0213;ASSIGNED BY ATI
TGTAY0213;TYPE/SUBTYPE OF PERSONNEL/UNKNOWN ASSUMED
```

```
        RQDR EFF:15;ACTUAL EFF:15;    RQRD VOL:  ;ACTUAL VOL:   ;

             FU          SHELL       FUZE      RD   VOL   EFFALONE
         / /C/5 /16   HEC3/HFC3   TIC /TIC     4            7
         / /A/5 /16   HEC3/HEC3   TIC /TIC     4            9
         / /B/5 /16   HEC3/HEC3   TIC /TIC     4            9
8N FIRING ALONE  EFF  VOL  RD       3N FIRING TOGETHER  EFF  VOL  RD
   5 /16         15         32            5 /16          15         32
```

A TACFIRE output message generated by the fire mission request for additional fire (FM;RFAF) input message which provides artillery target intelligence and mission data.

3. HELPs. HELPs are another form of fixed alphanumeric displays. The command method utilized affects the format of the HELP.

4. Error messages. Error messages provided through the system are yet another form of fixed alphanumeric displays.

b. Variable alphanumeric displays. The essential characteristic of variable alphanumeric displays which distinguishes them from fixed alphanumeric displays is that their construction and content are under user/operator control. Variable alphanumeric displays are provided through methods comparable to fixed displays, i.e., through lists or display formats. Lacking any rigid structure into which information must be formatted, variable alphanumeric displays are most useful for generation of:

1. Free text reports when the substence and structure of the report are up to the generating user/operator.

2. Shoe box files or personal files through which the user/operator generates HELPs, interim sets of data, or any set of personally useful operational information.

2.1.5 RECOMMENDATIONS FOR ALPHANUMERIC DISPLAYS

a. Table 2.1-1, Method of Alphanumeric Display by Application, presents general recommendations for the use of particular displays according to the type of output required by the user/operator.

b. Use alphanumeric displays to present alphanumeric information by which the user/operator can control the system.

c. Use alphanumeric displays to allow the user/operator to interact with the system on a non-*pro forma* basis, i.e., for the generation of user/operator-unique working files, frequently referred to as "shoe box files."

d. Use alphanumeric displays to permit user/operator generation of standard and nonstandard output reports in both textual and tabular formats.

e. Allow the user/operator to use alphanumeric displays to tag and/or annotate graphics displays.

Table 2.1-1. Method of Alphanumeric Display by Application

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION: LAYOUTS FOR DATA ENTRY	DATA DISPLAY FOR INFORMATION OR ACTION	DISPLAY OF PERFORMANCE OPTIONS	PRESENTATION OF HELPs	PRESENTATION OF ERROR INFORMATION
FIXED ALPHANUMERIC DISPLAYS					
LISTS	4	1*	1*	2	3
PRESTRUCTURED FORMATS	1	1	2	2	2
HELPs	4	1	2	1	4
ERROR MESSAGES	4	2	3	4	1
VARIABLE ALPHANUMERIC DISPLAYS					
FREE TEXT REPORT	2	2	1	4	4
SHOEBOX (PERSONNEL) FILES	2	2	1	2	2

*Recommended as 1st choice for standardization purposes.

2.1.6 ADVISORY COMMENTS FOR ALPHANUMERIC DISPLAYS

a. Fixed alphanumeric displays

1. Build fixed formats for alphanumeric data in accordance with the source data. Allow space for the longest legal entry; if grouping of data elements is required, make the groupings agree with those of the source data. Do not vary formats for identical data element structures.

2. Give each display frame a unique identifier, i.e., a name or a number. When multiple frames are necessary to complete a display, give each display frame an identifier which shows how that frame fits into the total picture.

   EXAMPLE: PERS LIST, FRAME 1 OF 4

3. Identify all fixed fields with a field label. Even frequently used fields having a standard format need a field label.

   EXAMPLE: DATE: __/__/__; (for month, day, year.)

4. Left justify text and other alphanumeric formatted data, Right justify numerical/tabular data. Do not require leading zeros in numerical data except where needed for precision.

   EXAMPLE:

	USE	DO NOT USE
NUMBER OF TANKS:______;	17	000017
NUMBER OF SOLDIERS:______;	66	000066
RATIO: SOLDIERS TO TANKS:______;	3.882	000.882
RATIO: TANKS TO SOLDIERS:______;	.258	000.258

5. Design the fixed format for data input to match the output unless such requirements impose difficulty or overburdening on the user/operator.

6. When providing on-line HELPS and/or error messages, present them each in a consistent format and at a consistent location on the screen.

7. Make HELPs and error messages clear, concise, and self-contained. That is, provide all necessary information for helping in the data entry or correction without sending the user/operator to external data sources.

8. Make terminology used in HELPs and error messages consistent with terminology used elsewhere in the system.

9. When menus are used to present user/operator options, allow selection of a menu item by a number and/or letters, if appropriate. Use "1" as the first entry. However, when a series of menus provides some of the same but selected options, assign a consistent number to each menu option. Always present menu options in ascending numeric sequence, skipping those numbers which are inappropriate in a given menu.

10. When alpha or alphanumeric information is presented for scanning purposes, present the data in a left-justified format. Use indentations to identify subclassifications.

```
EXAMPLE:  DISPLAY OPTIONS
             RETRIEVE DATA
             STORE DATA
             DISPLAY DATA
                ALPHANUMERIC
                NUMERIC
                SYMBOLIC
                   COMBAT EQUIPMENT
                   AIR EQUIPMENT
                   TRANSPORTATION EQUIPMENT
          ENTRY OPTIONS
             STORED DATA
             SYSTEM CALCULATION
             USER/OPERATOR-ENTERED DATA
```

11. When standard categories of information are presented in a variety of formats across the system, assign functional fields to specific areas of the format/screen. In effect, then, areas of the format/screen are reserved for particular types of information such as: header, data entry area, HELPs, alarms, error messages.

12. When columns of information are displayed, each column should have a heading. Use only upper-case letters for headings.

13. When columnar data are presented, line-by-line associations should be easily and clearly apparent. Providing additional spacing between li[illegible] placing columns close together--but not so close that entries bump into each other--will help. Lists should have only one item to a line.

14. Align lists of comparable numerical data containing decimals by the decimal point.

```
EXAMPLE:                  USE         DO NOT USE

                        15.985          15.885

                         4.65             4.65

                    21,535.621      21,535.621
```

15. Organize fixed formats on a logical basis to eliminate the need for excessive user/operator movement of the cursor in entering data. Any of a variety of data grouping strategies may be used. One of the following organizing strategies may be appropriate:

    (a) Source data sequence, as found on a listing or a standard reporting format.

    (b) Time-ordered sequence, appropriate for demonstrating a chronicle of events. The nature of the situation will dictate whether the sequencing should proceed from "last to first" or "first to last."

    (c) Frequency of use, placing those categories of information more routinely used at the beginning of the format and those categories used only infrequently at the end of the format. When such a structure is used in a multiple series of displays per format, allow the user/operator to "escape" when no further entries are to be made.

    (d) Importance or immediacy to the user, placing the most imperative or critical data at the beginning of the format.

    (e) Use sequence, placing that data most frequently used at the beginning of the format or grouping categories of data together on the basis of the frequent association.

    When conflicts arise among the above strategies, an arbitrary selection of formatting priority is required.

16. Permit the user/operator to scroll back and forth between screens when working with a multiple screen display.

17. Allow the user/operator when completing data entry in a fixed format to delete unprotected data from an output as appropriate to the task. Do not permit the user/operator to delete protected fields even if no entry is required in that field.

b. Variable alphanumeric displays

NOTE: Many advisory comments provided for fixed alphanumeric displays may also be appropriate to variable alphanumeric displays in the sense that once the display parameters are selected they become "fixed," at least for that application. These considerations may be particularly relevant to the development of shoe box or personal files which may later be incorporated into standard fixed displays. Thus, the preceding advisory comments for fixed alphanumeric displays should be reviewed for applicability to construction of specific variable alphanumeric displays.

1. In free text output messages, avoid hyphenation of words at the end of a line. If hyphenation is used, have the system apply simple rules for breaking words into conventional syllables.

2. In free text output, specify a sentence word length limit and provide a warning to the user/operator that the sentence length limit has been reached or exceeded. This encourages the user/operator to construct simple straightforward sentences.

3. In free text construction, permit the user/operator to determine output parameters such as: upper/lower case, line length, spacing, heading style and placement, indentations.

4. Allow the user/operator to organize the screen for data entry or output as appropriate to the task. The type of data will indicate whether output should be textual or tabular, formatted or unformatted.

5. The system needs to know that it has come to the end of a display when display construction and length are at the discretion of the user/operator. Require the user/operator to provide a notation such as "END OF DISPLAY" or "END OF LIST" before the system can process the display.

6. Make sample displays showing good/readable output accessible to the user/operator through the system. Sample displays should be representative of textual and tabular presentations, and attend to such parameters as line and column separations, density of the screen, and use of highlighting.

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2.2 Graphics Displays

2.2.1 DEFINITION

Graphics displays are screen or hard copy diagrammatic or pictorial presentations. The information provided here on graphics displays describes conditions and techniques for their utilization as well as display characteristics. In addition to providing guidance for the design of the graphics display, these guidelines also address the content and composition of alphanumeric information which supports the graphics presentation.

2.2.2 APPLICATIONS FOR GRAPHICS DISPLAYS

Use of graphics displays is particularly appropriate for:

a. Display of relative quantities or other measures of things.

EXAMPLE: The commander's briefing requires presentation of relative strengths of friendly and enemy tank forces within a given battle zone. A frequency polygon is generated in which a stylized diagram of a tank represents a tank platoon. Friendly forces are shown in green; enemy forces are shown in red. Iterative callup of the representational tank, linear placement of successive tanks, and coloration permit generation of the frequency polygon.

b. Representational presentation of relationships.

EXAMPLE: The commander's briefing also requires presentation of the organizational structure of a group of field units. As well as depicting the command structure, the type of communication links between field units is to be displayed. Command structure is drawn as an organization chart. Various shape codes are used to differentiate unit levels; different colors are used for connecting lines to demonstrate communication channels and type between units and organizational levels.

c. Display of topographic features in a representational framework.

EXAMPLE: In a system which provides data processing support to tactical command and control, a graphics capability is provided. Maps, which are displayed on a plasma screen, can be enhanced by entry/deletion/movement of special symbols and creation of additional symbols--all through use of a series of fixed function keys. The generated symbols (whether standard doctrinal symbols or newly created symbols) can be superimposed on a displayed map to demonstrate, for example, current, future, or historical status of a given geopolitical area. Or, successive overlays can be prepared to show a variety of topographic features, e.g., terrain features, cultural features, rainfall.

d. Creation of "free form" drawings and sketches.

EXAMPLE: An artillery system projects battle strategies on the basis of, for example, terrain and cultural characteristics, fire power, personnel, and interim battle outcome parameters. The tank commander, working on a map grid of the battle are creates various map overlays to aid in the planning of battle strategies. Strategies can reflect, for example, destroyed/not destroyed terrain and cultural features; personnel levels available as a result of battle; gun availability and ammo levels; terrain conditions for tank movement. This system does not have the capability to deal with real-time events on an automatic basis. However, the capacity to deal with time-bound events (e.g., rate of advance, time to complete a maneuver) permits the tank commander to project time into the battle strategy.

e. Display of imagery.

EXAMPLE: Certain types of "field information" are required to be maintained on a continuing basis at headquarters. These data are measured and transmitted automatically as telemetered data. At the receiving station at headquarters, the pulses are converted to automatic graphics output, sometimes in the form of line drawings, sometimes in the form of bar charts, sometimes in the form of color graphics.

2.2.3 BENEFITS OF GRAPHICS DISPLAYS

Use of graphics displays has the following benefits for overall system performance:

a. Reduced error rates, by minimizing:

1. Inability of the user/operator to clearly discriminate symbology or to misinterpret the meaning of display symbols.

2. Accidental selection of the wrong symbol(s).

3. Failure to follow the correct line in multivariable trend displays.

4. Misestimation of parameter values in quantitative presentations.

5. Failure to correctly identify depicted installations or equipment due to inadequate contrast or resolution in the soft copy display or in the conversion from soft copy to hard copy.

b. Increased system throughput rates, by minimizing:

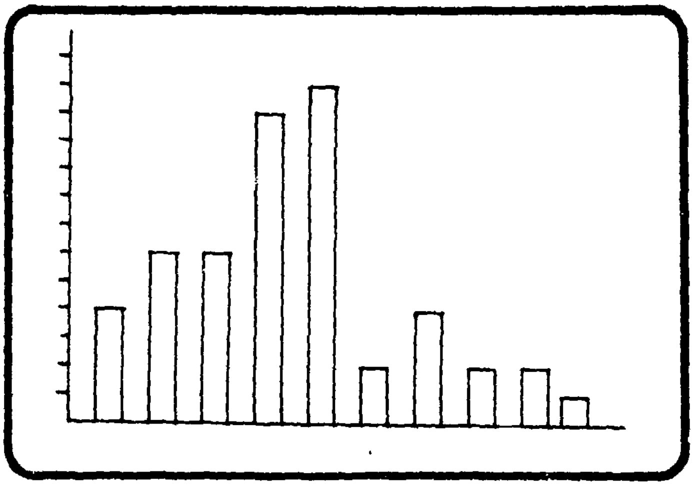
1. Time required to locate desired information.

2. Time involved in intergrating information.

3. Time required to correct errors of identification and interpretation.

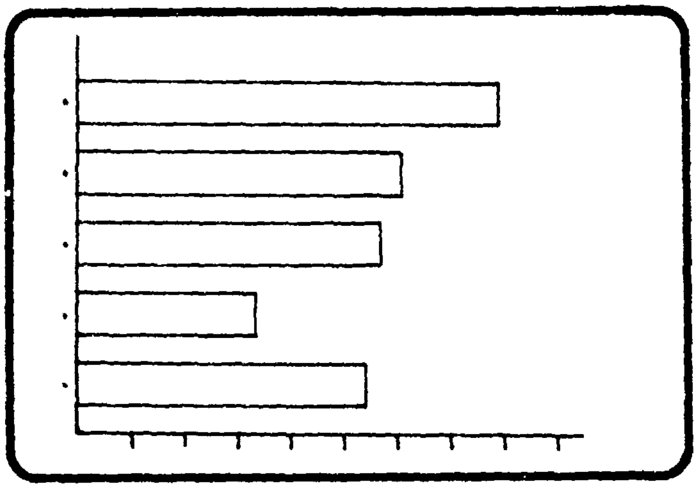
2.2.4 METHODS FOR GRAPHICS DISPLAYS

a. Bar graph, bar chart, histogram. These are common names for a graphics display which consists of a series of bars or rectangles with lengths proportional to specific quantities of a measured item. In this instance the bar graph might be representing the number of tanks to be delivered to an armored division each successive week over a ten-week period. Or, the bar graph might be reporting the number of tanks damaged daily over a ten-day period. In this example, time is shown along the horizontal axis and the proportional value is shown vertically.



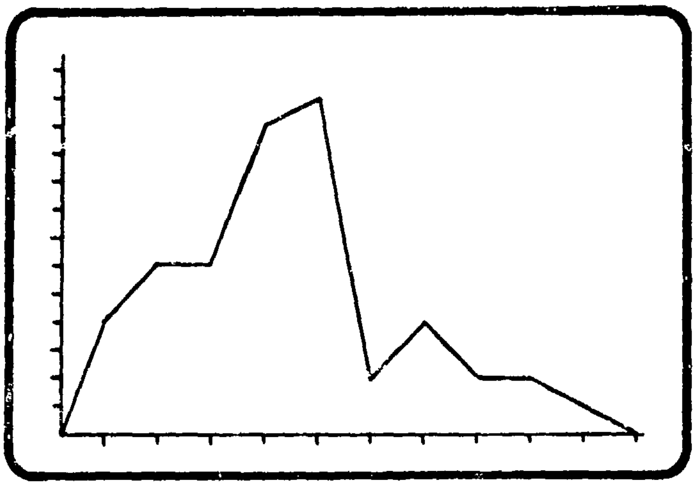
Sample vertical bar graph.

Bar graphs can also be oriented in a horizontal direction, as shown below. This display might be reporting, for example, average unit strength per year over a five-year period. In this instance, time is set along the vertical axis and unit strength is shown horizontally.



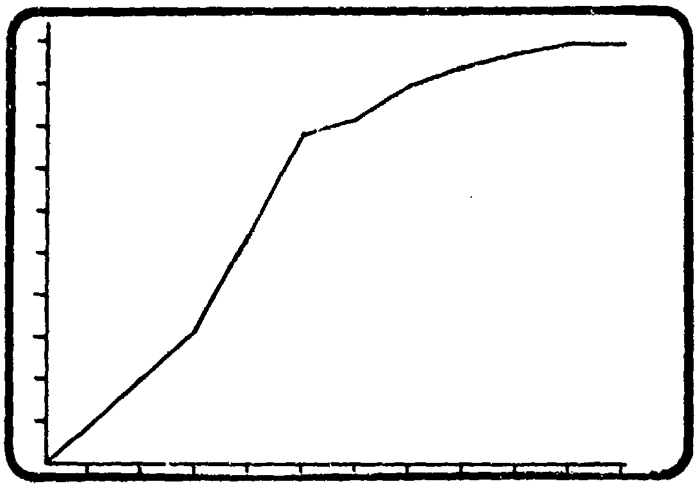
Sample horizontal bar graph.

b. Frequency polygon, trend analysis. The same vertical arrangement shown in the first example of graphic display methods can be used to demonstrate a fluid progression of the measures. This is achieved by plotting the quantitative measure at the midpoint of the interval and connecting the dots. A frequency polygon is often more appropriate than a bar graph for continuous data. Another name for this type of graphics display is trend analysis.



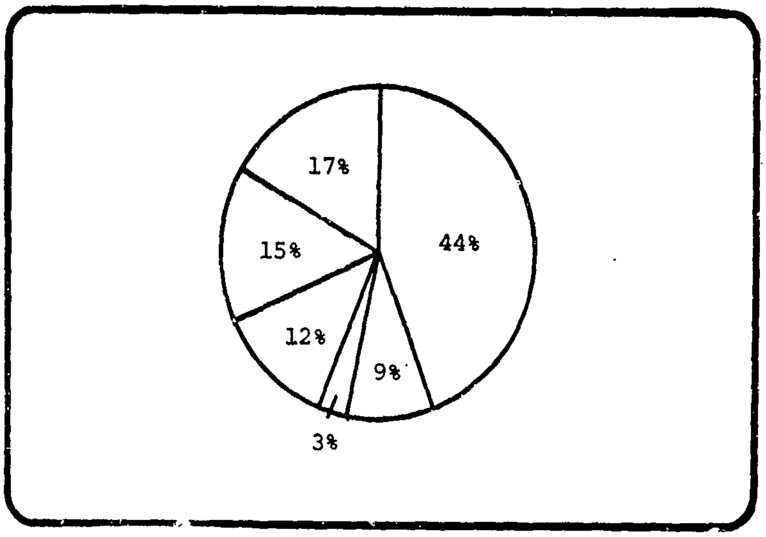
Sample frequency polygon.

A cumulative frequency polygon is sometimes an appropriate method to demonstrate effects over time. The data presented above are converted to a cumulative frequency polygon in the following display.



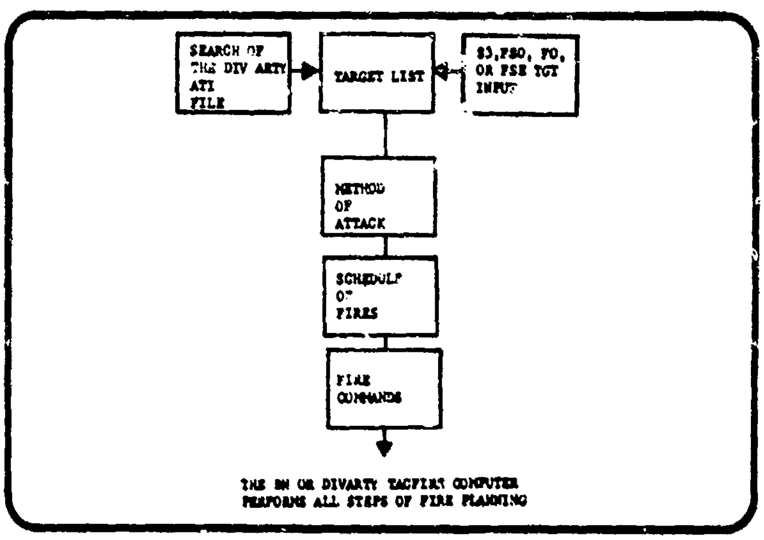
Sample cumulative frequency polygon.

c. Pie chart. The pie chart is another form of graphics display for demonstration of quantitative relationships. A primary difference in application between pie charts and bar charts, as well as between pie charts and frequency polygons, is that the pie chart readily communicates not just relative amounts but the quantity as a portion of the whole.



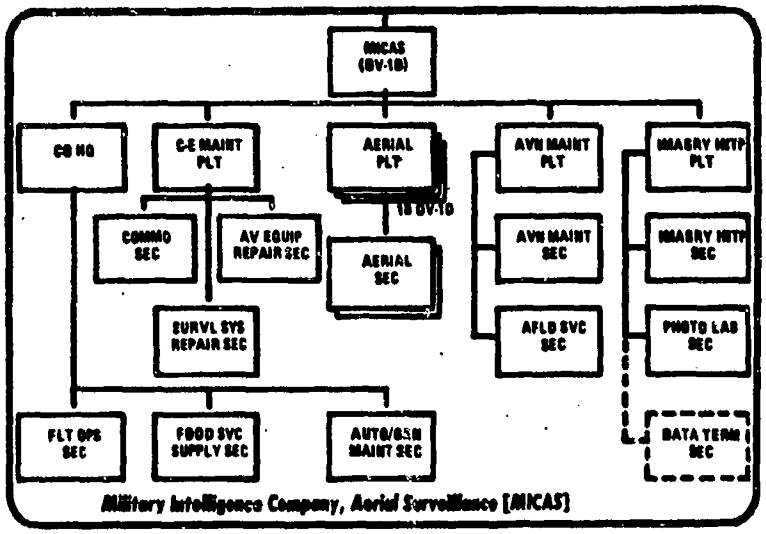
Samp.e pie chart.

d. Flow chart, organization chart. Flow charts and organization charts demonstrate nonquantitative relationships. Typically, these graphics deal with positional, hierarchical, functional, or sequential relation hips. The following flow chart demonstrates the sequence of actic s requi.ed in TACFIRE's preparation of a schedule of fires.



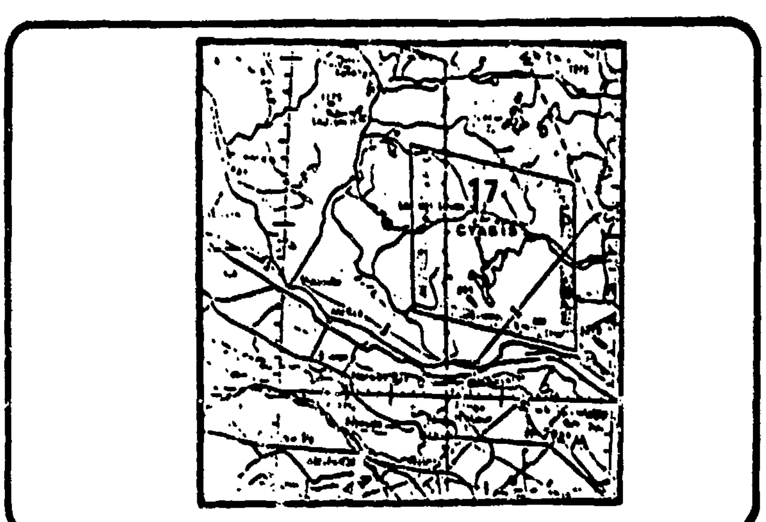
Sample flow chart.

The following flow chart permits ready comprehension of the components and unit relationships of the aerial surveillance function of a military intelligence company. This display also indicates that there are 18 fixed-wing OV-ID planes which furnish data and that a data terminal section within the company is an optional configuration.



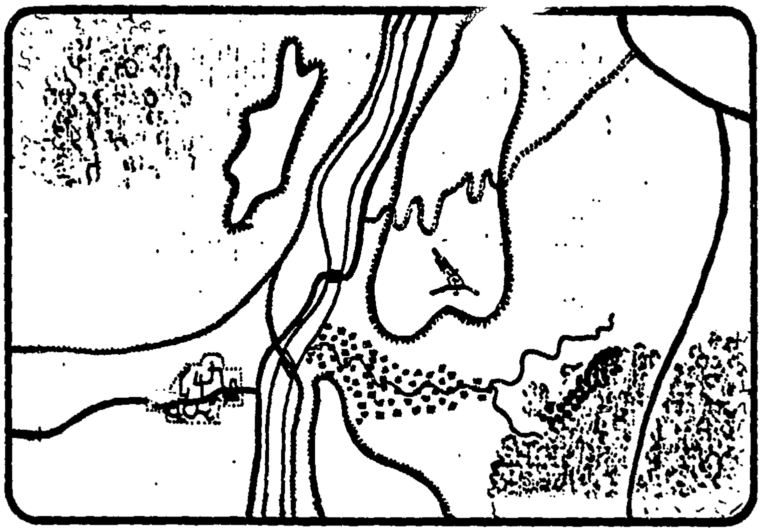
Sample organization chart.

e. Map, map overlay, and chart. Maps and charts are very versatile forms of graphics displays. Maps usually depict the topographic--the natural and/or manmade--features of a geographic area. The term chart is usually used to refer to navigational maps showing coastlines, water depths, celestial, or other information of use to navigators.



Sample map.

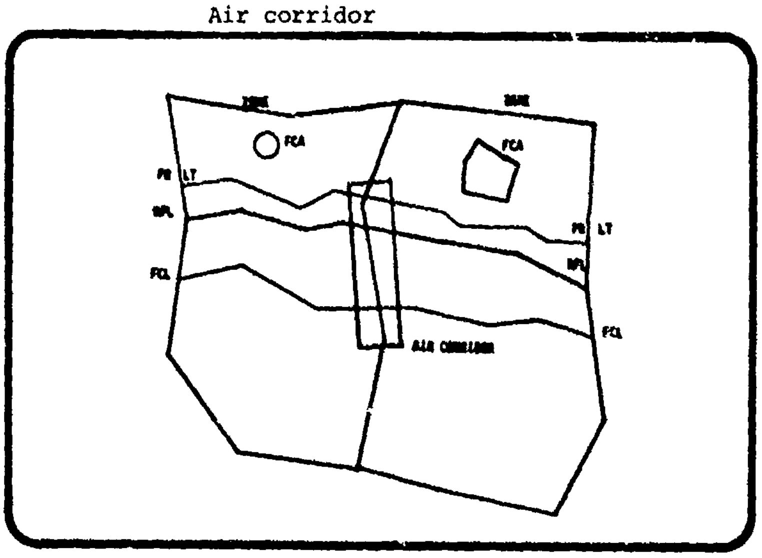
Map overlays permit conversion of a basic map to maps which feature particular aspects of the geographic area, e.g., elevation, rainfall, equipment emplacement. The following figure uses an overlay with symbolic notations to indicate both terrain features and equipment placement.



Sample map overlay.

f. Line drawing. The capability to create line drawings makes the system very powerful in terms of the types of information which can be generated. Almost any kind of "representation," from abstract to near photographic quality, can be produced. The following line drawing depicts fire control geometry measures, as follows:

Zone of responsibility
Fire coordination area (FCA)
Front line trace (FRLT)
No fire line (NFL)
Fire coordination line (FCL)
Air corridor



Sample line drawing.

2.2.5 RECOMMENDATIONS FOR GRAPHICS DISPLAYS

a. Use graphics displays when demonstrating simple operational relationships to the user/operator.

b. Allow the user/operator to generate graphics displays when demonstrating quantitative relationships of data categories.

c. Use graphics displays for the presentation/interpretation of data generated through automation.

d. Do not use graphics displays when an excessive number of data parameters is included. A 3 x 7 format is probably maximum for most quantitative graphics formats.

e. Do not use graphics displays for quantitative data when measures are inordinately out of balance. Relationships on the order of from 2 to 10 to one are appropriate for graphics display. Relationships on the order of 50 to 100 to one are inappropriate.

f. Add alphanumeric tag and annotation capability to graphics displays capabilities to enhance their meaningfulness.

g. Table 2.2-1, Method of Graphics Display by Application, presents general recommendations for the use of particular displays according to the type of output required by the user/operator.

Table 2.2-1. Method of Graphics Display by Application

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION: DISPLAY OF RELATIVE QUANTITIES OR MEASURES	REPRESENTATIONAL PRESENTATION OF RELATIONSHIPS	DISPLAY OF TOPOGRAPHIC FEATURES	CREATION OF "FREE FORM" DRAWINGS OR SKETCHES	DISPLAY OF IMAGERY
BAR GRAPH, BAR CHART, HISTOGRAM	1*	2	4	3	1
FREQUENCY POLYGON, TREND ANALYSIS	1	1	4	3	1
PIE CHART	1	2	1	3	2
FLOW CHART, ORGANIZATION CHART	4	1*	4	2	4
MAP, MAP OVERLAY, CHART	2	1	1*	1	1*
LINE DRAWING	1	2	1	1*	2

*Recommended as 1st choice for standardization purposes.

2.2.6 ADVISORY COMMENTS FOR GRAPHICS DISPLAYS

a. Bar graph, bar chart, histogram

1. Label the axes of bar graphs, bar charts, and histograms using consistent terminology and placement. Labels for the x-axis are generally centered and written horizontally. Labels for the y-axis are also generally centered, but written vertically.

2. Use only upper-case letters for labels.

3. Use mathematically meaningful subdivisions for intervals along the axes. For example, intervals of 1, 2, 5, and 10 are easily handled mentally. Seven is not usually a good interval since it is not divisible. However, if the user/operator is constructing week-by-week information on a daily report basis, secondary intervals indicating the seven days of the week are appropriate.

4. Make separations and distinctions between/among different data readily apparent by using shading and/or color coding.

5. Keep a good balance in the bar graph, chart, or histogram. Long skinny "sticks" with wide spaces between them are poor layout. Use wider columns with smaller spaces between the columns so that comparisons and actual data readings are easier to make.

6. Do not over-identify points along the axes. Intervals of 5, for example, can be marked and annotated at only the "tens" intervals and still communicate the 5-level intervals very readily. On the other hand, providing annotation at only every fourth or fifth interval causes confusion in interpretation.

7. Do not attempt to put excessive amounts of data into a single chart; make multiple charts instead. The point of the graphics display is to provide rapid and accurate communication of the "sense" of the data. Provide the raw data--preferably in tabular form--as back-up.

b. Frequency polygon, trend analysis

NOTE: Because of the comparability of layout, many of the advisory comments provided for the bar graph, bar chart, and histogram are appropriate to the frequency polygon and to trend analysis. Review those advisory comments for applicability to construction of specific aspects of frequency polygons and trend analysis.

1. If trends are to be compared, place multiple trend lines on a single grid rather than using multiple grids with only a single trend line per grid.

2. Provide unique trend line symbols when trend lines intersect.

3. When line crossings are such that intersections can become confused, use unique trend line symbols as well as unique line structures (solid, dashed, dotted lines, and combinations thereof).

4. If the system has a color graphics capability, use color coding of lines to help eliminate line crossing confusions. Color coding can be used to substitute for line structure coding or to amplify the line structure coding.

c. Pie chart

1. Provide a clear label for each segment of the pie chart. When a given segment of the pie chart is too small to hold the label, place the label outside the segment and draw an arrow to the segment.

2. When the user/operator might have need for the actual data rather than just make comparisons (e.g., 76% and 14% versus "larger" and "smaller"), provide the actual numerical notations within the segment. Again, if there is not space within the segment to clearly indicate the value, place it outside and draw an arrow to the appropriate segment.

3. Place upper and lower limits on the number of segments the user/operator can include in the pie chart. A minimum of 3 segments and a maximum of 9 is probably appropriate, although in some instances 2 segments might be a useful display. If data are such that more than 9 segments are possible, it will likely be useful to combine the smaller data elements into one group labeled "other." Under these circumstances, provide such a message to the user/operator.

4. Adding color to pie charts provides another dimension by which to make categorical comparisons stand out. Use colors in such a fashion so that adjacent colors are complementary rather than obtrusive and so that they do not create an interactive "blooming" or obliterating effect.

d. Flow chart, organization chart

1. Use flow charts and organization charts to communicate relationships among things and units and aspects of those relationships. When properly constructed, these charts can communicate relationships more quickly and concisely than textual information. When inserted into textual presentations, flow charts and organization charts support the textual presentation.

2. Symbolic/shape coding of elements contained in flow charts and organization charts provides a method for adding parameters of information or making distinctions between classes or elements.

3. Use color coding of lines to demonstrate different types of relationships among elements included in the chart.

4. Always provide a key to symbolic and color codes.

5. A great variety of detailed information can be displayed through the combination of symbolic and color coding of elements of flow charts and organization charts. However, be careful not to overrule the intended simplicity by incorporating too many dimensions of symbolic and color coding into the chart.

e. Map, map overlay, chart

1. Use standard/doctrinal symbology on maps, map overlays, and charts when available.

2. When standard symbols have not been identified for specific things, features, or conditions, make simple, clear, distinctive symbols as representative as possible. Stick to meaningful graphics construction. Use consistent symbols from situation to situation so that symbology has consistent meaning within the system, at least.

3. Position symbols on the map grid at exact locations. When this is not possible, position the symbol near the location and draw an arrow to the exact location. For accuracy purposes in some instances, it will be necessary to provide coordinates of the exact location along with the symbol.

4. Do not draw/place one symbol over another unless they can both be clearly and unambiguously identified.

5. Orientation of the map symbol may be, in some instances, as important as the location of the symbol.

6. The positional accuracy of symbols (or even their deletion) is affected by the speed with which the symbol manipulation is made.

7. Color and shading are important dimensions in map construction and permit a great variety of detail. Be aware, however, of interactive effects of colors and of color shading. The addition of too much detail through symbolic, color, and shading coding will obscure the intended meaning of the map.

f. Line drawing

1. Allow the user/operator to use line drawings as illustrations to support textual information.

2. The accuracy and quality of the line drawing often is affected by the speed with which it is made. Take quality and accuracy requirements into account when making line drawings.

2.3 Selective Highlighting

2.3.1 DEFINITION

Selective highlighting is the application of illumination, color, graphics, and/or other techniques to produce visual effects which announce clearly to the user/operator that selected portions of a display have greater importance or significance than other portions. Highlighting is appropriate to any of the display types previously discussed. However, methods and applications of highlighting, as well as purpose, differ by display type. Highlighting makes it easier for the user/operator to find and keep track of the most important or critical information in the display.

2.3.2 APPLICATIONS FOR SELECTIVE HIGHLIGHTING

Selective highlighting is appropriate for the following circumstances:

a. To call attention to unusual values or information.

EXAMPLE: A logistics system highlights types of equipment which are below recommended levels in a given company.

b. To identify information which has been changed during editing or some other form of data entry.

EXAMPLE: A user/operator changes the number of heavy tanks in the Order-of-Battle File for an armored division of a potential aggressor. Before the new information is stored, the system presents the user/operator with a list of some of the most important features of that portion of the Order-of-Battle File. In this list, the items which the user/operator has changed are highlighted.

c. To specify information which should be changed during editing or another form of data entry.

EXAMPLE: A file of information has been updated by reading a number of cards into the file. Some of the entries are wrong. An interactive portion of the system presents the data which have been entered into the system, with the erroneous data (as detected by the computer) highlighted.

d. To call attention to high priority codes or messages.

EXAMPLE: In an artillery data system, the user/operator must be certain that the target coordinates for a fire mission do not mean that friendly fire will impact on friendly forces. The data indicating these coordinates is therefore highlighted when it is displayed.

e. To indicate the nature of alarms.

EXAMPLE: In a communications system, the user/operator must decide how to distribute messages down the chain of command. While reviewing a set of relatively routine messages, an urgent transmission is received digitally. In a designated portion of the CRT display, the receipt of the urgent message is indicated and the source (or other information) of the message is highlighted.

f. To call attention to special areas or features of the display.

EXAMPLE: In an EW system, the user/operator must maintain special awareness of the location of emitters which are a threat to helicopters operating in ground support roles. In a map display, the area around the point of an Army thrust would be highlighted.

g. To indicate data entry error or command entry error.

EXAMPLE: In a logistics system, the user/operator is required to enter codes for equipment types for which information is to be retrieved. The system highlights the characters in the data string which are not valid.

h. To provide warning of the consequences of a given command entry.

EXAMPLES: In a system which stores and provides for update of order-of-battle information, a user/operator specifies the deletion of a particular type of data element from the entire Order-of-Battle File. The system prints out a message warning the user/operator that execution of this command will require several hours, and that the information contained in this data file will no longer be available on-line. This message is highlighted.

i. To identify search targets.

EXAMPLE: An intelligence system displays the location of potential aggressor units on a map display. For the purposes of planning for a particular operation, the user/operator is particularly concerned about the location of armored units. By entering the appropriate command, the user/operator causes the symbols indicating armored units to be highlighted on the display.

j. To differentiate among different levels of a multivalued variable.

EXAMPLE: Ammo available is displayed on a status board for the Commander's briefing. Adequacy of available ammo is depicted by a color code: green = adequate supply; yellow = close to minimum requirements; red = below minimum requirements. The percentage at which the color indications appear vary according to peacetime/battle condition.

k. To locate the screen area where the "next action" will take place.

EXAMPLE: In an administrative system, the user/operator must enter requests for medical supplies into a prestructured format which requires the drug supply code, the size, and the quantity in a columnar format. A blinking cursor indicates where the next keyed-in data entry will appear.

l. To indicate need for data or command entry.

EXAMPLE: In a field artillery system the user/operator, when planning a firing mission, has the option of providing some types of data but some types of data must be entered before the messages can be forwarded. If the instruction to forward the message is rejected because of missing essential data, the data field label blinks until the field is filled in.

2.3.3 BENEFITS OF SELECTIVE HIGHLIGHTING

Appropriate utilization of selective highlighting:

a. Reduces error rates, by minimizing:

1. Failure to perceive or attend to significant or important items of information.

2. Confusion about operational requirements.

b. Increases system throughput rates, by minimizing:

1. Time to recognize and attend to important or significant information.

2. Time associated with differentiation of the priorities of requirements or information.

2.3.4 METHODS OF SELECTIVE HIGHLIGHTING

a. Brightness control. The information which is highlighted appears brighter than other information on the display.

NO MATCH ON FILE NAME "CHKSUM"

DO YOU WISH TO:

1. **ENTER** A NEW RETRIEVAL NAME
2. **REVIEW** THE VALID FILE NAMES
3. **PERFORM** ANOTHER OPERATION

-->

b. Character size control. The information to be highlighted is presented in larger characters than that which is not to be highlighted.

NO MATCH ON FILE NAME "CHKSUM"

DO YOU WISH TO:

1. ENTer A NEW RETRIEVAL NAME
2. REView THE VALID FILE NAMES
3. PERform ANOTHER OPERATION

-->

c. Uppercase display. The highlighted information is presented in all capital letters.

```
NO MATCH FOUND ON FILE NAME "CHKSUM"
DO YOU WISH TO:
    1. ENTer a new retrieval name
    2. REView the valid file names
    3. PERform another operation



-->
```

d. Reverse video or reverse display. The colors of the letters or characters and the colors of the background on which they are presented are reversed.

```
NO MATCH FOUND ON FILE "CHKSUM"

DO YOU WISH TO:
    1. ENTER A NEW RETRIEVAL NAME
    2. REVIEW THE VALID FILE NAME
    3. PERFORM ANOTHER OPERATION



-->
```

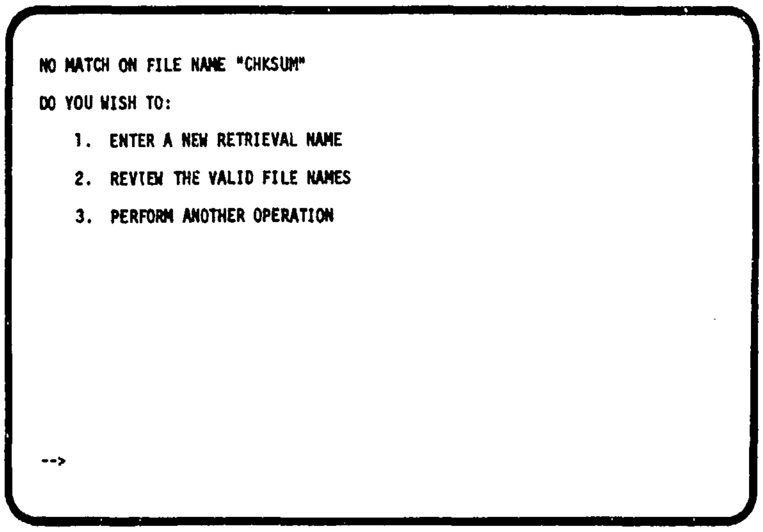
e. Underlining. Important information on the display is underlined.

```
NO MATCH FOUND ON FILE NAME "CHKSUM"
DO YOU WISH TO:
    1. ENTER A NEW RETRIEVAL NAME
    2. REVIEW THE VALID FILE NAMES
    3. PERFORM ANOTHER OPERATION

-->
```

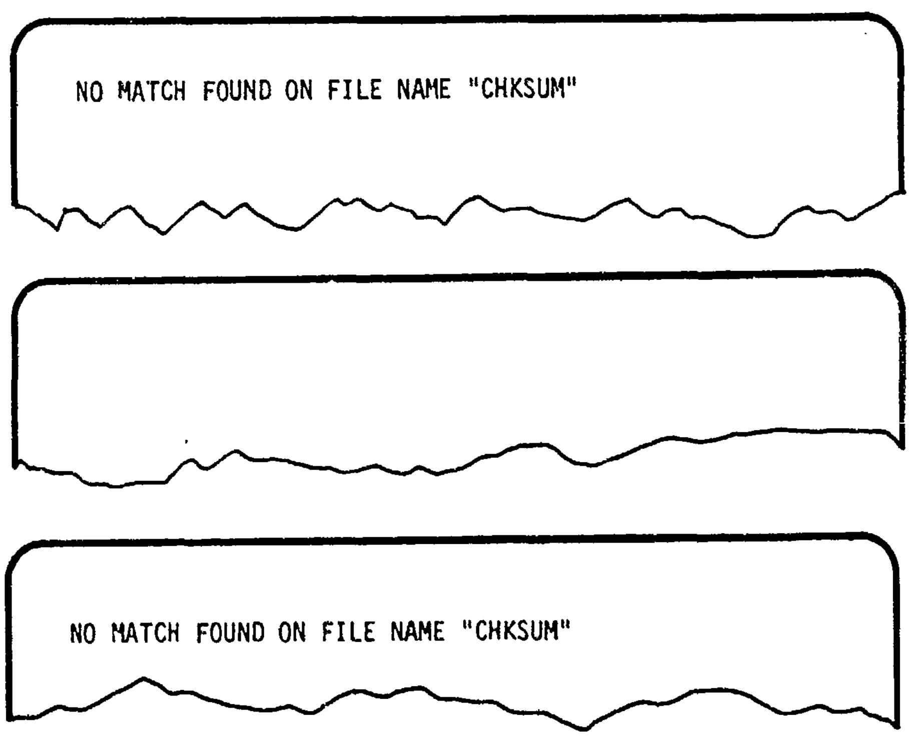
f. Mixed character fonts. The highlighted information is presented in a type style different from nonhighlighted information.

```
NO MATCH FOUND ON FILE NAME "CHKSUM"
DO YOU WISH TO:
    1. ENTER A NEW RETRIEVAL NAME
    2. REVIEW THE VALID FILE NAMES
    3. PERFORM ANOTHER OPERATION

-->
```

g. Color contrast or colorcoding. The highlighted information is presented in a color that is different from other information.



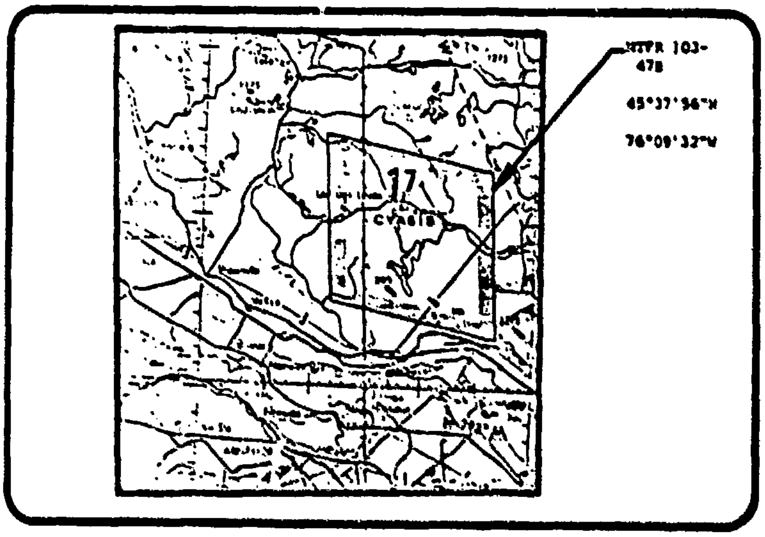
h. Blinking, flashing, or pulsating. The highlighted information blinks rapidly on and off.



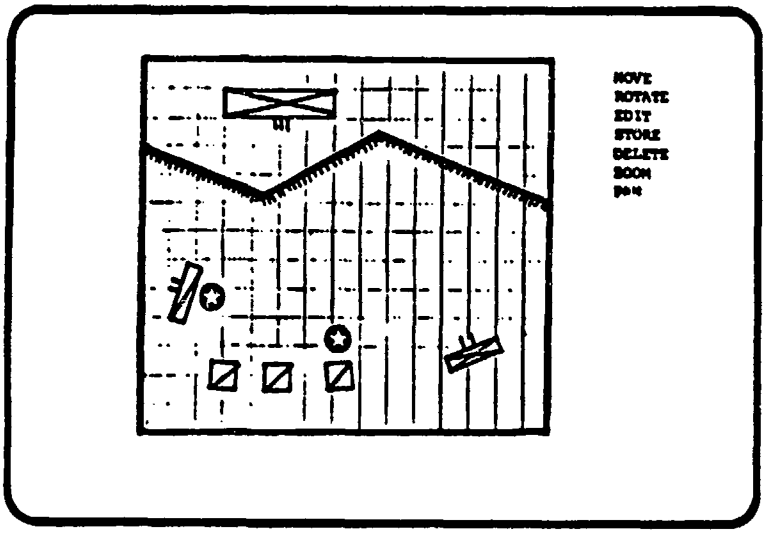
i. Boxing or surrounding. The highlighted information is contained within a box formed by lines or symbols.

```
******************************************
* NO MATCH FOUND ON FILE NAME "CHKSUM" *
******************************************

***  *****
*1*  *ENT*ER A NEW RETRIEVAL NAME
***  *****

***  *****
*2*  *REV*IEW THE VALID FILE NAMES
***  *****

***  *****
*3*  *PER*FORM ANOTHER OPERATION
***  *****




-->
```

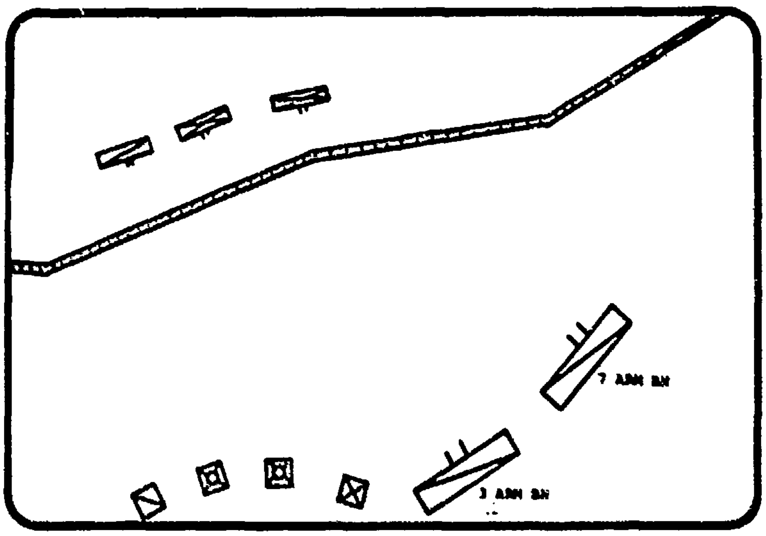
j. Arrowing. An arrow drawn on the display indicates that an item in the display is worthy of special attention.



k. Symbolic tagging. A symbol located near an item or group of items on the display indicates that it (they) are worthy of special attention.



l. Alphanumeric tagging. Groups of characters located near information in the display indicate that these items are important.



m. <u>Position displacement</u>. Information is highlighted by moving it out of its "normal" position.

```
THE FOLLOWING IS AN ALPHABETIZED LISTING OF THE PERSONNEL IN THE
THIRD ARMORED BATTALION WITH HIGHER THAN AVERAGE RATINGS BY
SUPERIORS:

     AARONS, A.J., SP-4
     ABRAMS, B.F., SP-5
   ANDERSON, M.F., SP-4
     BUTLER, F.C., E-3
     CAVANAUGH, R.T., SP-5
     CELLINI, B.T., E-5
     COSKOWITZ, R.T., SP-5
   DOTLICH, G.L., E-4
     ERMANDO, S.R., SP-4
     EXETER, D.D., E-5
   FRANCESCA, H.J., SP-5
   GALLOWAY, O.L., SP-5
          .
          .
          .
```

2.3.5 RECOMMENDATIONS FOR SELECTIVE HIGHLIGHTING

a. Table 2.3-1, Method of Selective Highlighting by Type or Format of Output Display, presents a general list of recommendations for the use of particular types of highlighting according to the type of output device which the user/operator will be viewing. Before making a final decision on the method of selective highlighting, be sure to consult the chart showing recommendations for highlighting method for particular applications (Table 2.3-2), as well as the detailed discussion of highlighting methods presented in Section 2.3.6, Advisory Comments on Methods of Selective Highlighting.

b. Use selective highlighting to indicate information in a display which is significantly more important than other information in the display.

c. Use highlighting when it is desirable to gain the attention of the user/operator.

d. Do not use selective highlighting when the amount of information to be highlighted exceeds ten percent of the total information in the display.

Table 2.3-1. Method of Selective Highlighting by Type or Format of Output Display

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT OPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

		TYPE OR MEDIUM OF DISPLAY			
		Alpha-numeric CRT Terminal	Graphic CRT Terminal	Alpha-numeric Hard Copy Terminal or Printer	Plotter, Printer/Plotter
METHOD	Brightness Control	1*	1*	4	4
	Character Size Control	1	1	1*	1*
	All Upper Case	2	2	2	2
	Reverse Display	1	1	4	4
	Underlining	2	2	2	2
	Different Font	2	2	1	2
	Color Control	4	1	4	1
	Blinking, Pulsating	3	3	4	4
	Boxing	2	1	2	1
	Arrowing	4	2	4	2
	Symbolic Tagging	4	2	4	2
	Alphanumeric Tagging	3	3	3	3
	Position Displacement	3	3	3	3

* Recommended as 1st choice for standardization purposes.

Table 2.3-2. Method of Selective Highlighting by Reason for Using Highlighting

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION: Unusual Values	Information Changed	Information to be Changed	High-Priority Messages/Codes	Alarms	Special Areas of Display	Command/Data Entry Errors	Warnings of Consequences	Indicate Search Targets
Brightness Control	1*	1*	1*	1*	2	1*	1*	1*	1*
Character Size Control	1	1	1	1	4	4	1	1	2
All Upper Case	2	2	2	2	3	4	2	2	4
Reverse Display	2	2	2	2	2	3	2	2	1
Underlining	2	2	2	2	3	3	2	2	4
Different Font	2	2	2	2	3	4	2	2	4
Color Control	1	1	1	1	2	1	1	1	1
Blinking, Pulsating	3	3	3	2	1*	3	4	3	2
Boxing	3	3	3	1	4	1	1	2	2
Arrowing	2	2	2	3	4	4	4	2	2
Symbolic Tagging	2	2	2	4	4	3	4	4	2
Alphanumeric Tagging	4	4	4	4	3	3	3	4	3
Position Displacement	2	2	3	3	3	4	4	2	2

* Recommended as 1st choice for standardization purposes.

2.3.6 ADVISORY COMMENTS FOR SELECTIVE HIGHLIGHTING

a. Brightness control

1. Do not use brightness control when more than three levels of brightness are employed.

2. Do not use brightness control when the lighting in the area where transactions must be performed is too bright to permit adequate discrimination of brightness levels in the display.

3. Do not use brightness control when the amount of illumination coming from the display will increase probability of detection of the user/operator by potential aggressor forces.

4. Do not use brightness control when its use will cause the user/operator to perform poorly on other tasks because the excess light from the display causes eye adaptation to the brightness of the display.

b. Character size control

1. Do not use character size control when it reduces the number of characters which can be placed on the display and increases the number of pages in a multi-page display.

2. Do not use character size control where the type of character used in highlighting decreases the legibility of the display.

3. Do not use character size control where the "blooming" or "blurring" of the larger characters decreases the legibility of other information in the display.

c. Uppercase display

1. Do not use all upper case where the legibility of the highlighted information is important. Use of all capital letters makes text difficult to read.

2. Do not use all upper case for highlighting where other information on the display would normally be presented in upper case, e.g., where the display contains military acronyms such as CINCPAC, CINCEUR, USAFE, etc.

3. Do not use all upper case where it would interfere with a code scheme in which lower case characters are required.

d. Reverse video or reverse display

1. Do not use reverse display when its use will cause the user/operator to perform his/her other tasks poorly because excess light from the display causes eye adaptation to the brightness of the display.

2. Do not use reverse display when its use increases the amount of light coming from the display, increasing the probability of detection of the user/operator by an enemy.

3. Do not use reverse display when the "blooming" or "blurring" caused by the bright background decreases the legibility of the display.

e. Underlining

1. Use underlining when maintaining the legibility of highlighted text is crucial.

2. Do not use underlining when highlighted characters and underline appear on two different display lines.

3. Do not use underlining when its use will require that the number of pages in the display be increased.

4. Do not use underlining when the underlining cannot be overlaid on the information to be highlighted.

5. Do not use underlining when "blooming" or "blurring" caused by the underlining reduces the legibility of highlighted or other characters.

6. Do not use underlining for highlighting when this technique is already being used for other purposes.

7. Do not use underlining for alarms or when it is crucial to gain the attention of the user/operator by means of selective highlighting.

f. Mixed character fonts

1. Do not use different fonts when the font which must be used for highlighting reduces the legibility of highlighted information.

2. Do not use different fonts when the difference between the two fonts is not sufficient to produce the distinctiveness required for highlighting.

3. Do not use different fonts when the amount of information needed to construct characters in that font increases transmission time.

4. Do not use different fonts for alarms or when it is otherwise necessary to gain the attention of the user/operator by means of selective highlighting.

g. Color contrast or color coding

1. Use color coding when the number of categories of highlighting is large.

2. Use red color coding if it is desirable to avoid user/operator adaptation to the brightness of the display.

3. Use the most easily readable color--usually yellow-green or white--for normal or unhighlighted information.

4. Use red color coding for alarms or other situations where it is necessary to gain the attention of the user/operator through the use of selective highlighting.

5. Use green color coding to indicate normal or nonalert status.

6. Do not use color coding when the available colors are of such density and hue that they are likely to be confused by persons with defective color vision.

7. Do not use color coding if the use of color reduces the legibility of highlighted or other characters.

8. Do not use color coding if lighting in the areas where users/operators interact with the system will cause the colors to wash out.

h. Blinking, flashing, or pulsating

1. Use blinking only for alarms or in other situations where alerting or gaining the attention of the user/operator outweighs the irritation and reduced legibility caused by blinking, flashing, or pulsating information.

2. Use blinking only when the highlighted information flashes "on" three to five times per second.

3. Do not use blinking where this form of highlighting cannot be turned off by the user/operator.

4. Do not use blinking when the terminal to be used has long-persistence phosphors which would cause the rate of blinking to be less than three to five times per second.

i. Boxing or surrounding

1. Use boxing when there is a need to highlight large amounts of text.

2. Use boxing to indicate "working" portions of a display.

3. Do not use boxing when the information to be highlighted is scattered more or less randomly throughout the display.

4. Do not use boxing when this form of highlighting would require increasing the number of pages of a display.

j. Arrowing

1. Use arrowing when there is a need to logically connect two symbols or groups of symbols such as connecting the code name of an organization to a chart symbol referring to that organization.

2. Do not use arrowing where many items must be highlighted simultaneously.

3. Do not use arrowing to indicate items to be scanned.

4. Do not use arrowing to indicate alarms or other high-priority messages and codes.

k. Symbolic tagging

1. Do not use symbolic tagging if other methods of highlighting are available.

l. Alphanumeric tagging

1. Use alphanumeric tagging where there is a need to provide a code link between a symbol on the display and more detailed information about the thing that the symbol represents, e.g., use the tag "3 ARM BN" to retrieve more information about a symbol on a map display which represents the position of the third armored battalion.

2. Do not use alphanumeric tagging where there is a pressing need for distinctiveness in highlighting.

3. Do not use alphanumeric tagging to highlight alphanumeric information, unless the tagging is accompanied by the application of other sorts of selective highlighting, e.g., brightness control, position displacement.

m. Position displacement

1. Use position displacement where vertically oriented lists of information must be rapidly scanned.

2. Use position displacement where displays which are to be scanned must be scrolled.

SECTION 3. DATA ENTRY AND HANDLING

Guidelines in this category suggest ways for maximizing the speed, accuracy, and efficiency of user/operator entry of data into the system. These guidelines encompass the following topics:

1. Information on Legal Entries--Deals with methods for presenting the user/operator with information on the content and format of data to be entered into the system.

2. Unburdening of Input--Provides techniques which simplify the data input process and allow the user/operator greater ease in entering data.

3. Interrupts and Work Recovery--Presents methods for minimizing the disruption caused when a processing halt occurs and for maximizing smooth transition during recovery.

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3.1 Information on Legal Entries

3.1.1 DEFINITION

Information on legal entries refers to information on the format (the structure) as well as the content (the kind) of data which comprise a legal entry. A legal entry is that data determined to be acceptable to the system; it depends upon system definition. Criteria for making that distinction include length requirement for data entry; the data field; type of element being employed, whether it be alpha, numeric, or special characters; and the appropriate sequence.

The use of such information provides the user/operator with the necessary knowledge to enter data appropriately.

3.1.2 APPLICATIONS FOR INFORMATION ON LEGAL ENTRIES

Information on legal entries should be provided to the user/operator when:

a. The format of the information to be entered is critical to the interpretation of the entry by the system.

EXAMPLE: In a particular tactical system, the user/operator must enter the date according to the format YYDDMM; another format, such as DDMMYY, will be incorrect. Information on legal entries permits the user/operator to determine the proper format.

b. The codes for a data field are limited in number and rigidly constrained in content.

EXAMPLE: In an order-of-battle data exploitation system, the software can recognize only certain codes specified for particular equipments. Thus, a user/operator who wants to refer to the Soviet T-72 heavy tank must enter "VTNK(T72)." Entering "SOVIET T72," "T-72 TANK," "SOVIET HEAVY TANK," "T72," or any other variant will be rejected by the system as an illegal entry. Information on legal entries provides guidance to the user/operator in determining the correct code for the data element he/she wants to represent.

c. The user's/operator's entry can be valid but still incorrect.

EXAMPLE: In a field artillery system, the user may have the option to select from a variety of types of rounds (high explosive, armor piercing, fragmentation, smoke, etc.). Thus, any one of several entries would be valid in response to the system's data entry prompt (e.g., "ENTER TYPE OF ROUND --"), even though only one might be appropriate for a particular situation. If the user/operator wants to call for high explosive rounds, but enters "SM" (for smoke) instead of "HE" (for high explosive), the system has no way to "know" that the entry is an error. Information on legal entries permits the user/operator to review the available options for the data entry field, and to select the code that matches his/her intentions.

d. The user/operator may have difficulty recalling valid codes because of inexperience or because the set of codes is large.

EXAMPLE: In a communications system, experienced users/operators have learned the codes to be entered into each of ten message formats. The system must, however, be able to operate even if all experienced users/operators have become disabled or otherwise unavailable. Information on legal entries will permit inexperienced personnel to continue system operations, even if with reduced efficiency.

EXAMPLE: In an administration system, the user/operator must enter a code to denote a particular type of medical supply. The

set of such codes is large, numbering into the thousands. Even highly experienced users/operators cannot remember all the codes and the medical item that each code represents. Information on legal entries assists the user/operator in selecting the code appropriate to a particular data item.

e. <u>The codes or terminology used in the system differ from corresponding standard codes used in most other situations.</u>

EXAMPLE: In a command and control system, the phrase "Free Fire Area" is coded as "FCA," rather than the doctrinal "FFA" as specified in FM6-20. Information on legal entries alerts the user/operator to the existence of such non-standard usages.

f. <u>The range of values for a numerical data field is limited.</u>

EXAMPLE: In an intelligence information system, the user/operator must enter latitudes in degrees. Entering the value "97" exceeds the legal limit for a latitude. Information on legal entries shows the user/operator the range of legal values.

g. <u>Each of the possible codes is lengthy.</u>

EXAMPLE: In a command and control system, the user/operator must enter a unit ID for companies which includes all of the unit's parent organizations up to division (for example, C Company, 1st of the 64th Armor, 2nd Brigade, 14th Armored Division must be entered as 14/2/1/64/C). Information on legal entries helps the user/operator to enter the required data.

3.1.3 BENEFITS OF INFORMATION ON LEGAL ENTRIES

Information on legal entries:

a. Reduces error rates, by minimizing:

   1. Failure to recall legal entries.

   2. Typographical errors made in entering long data entry strings.

   3. Errors resulting from failure to remember data entry codes after consulting HELP files or system reference manuals.

b. Increases system throughput rates, by minimizing:

   1. Time to locate legal values information.

   2. Time to display long lists of legal entries at the user terminal.

   3. Time to locate reference documents.

   4. Time to look through HELP displays.

   5. Time to correct errors.

3.1.4 METHODS FOR PRESENTING INFORMATION ON LEGAL ENTRIES

a. Input menus. Two types of input menus can be used to show the user/operator the legal entries for a data field, simple and hierarchical:

1. Simple input menus are used when the number of legal entries is small enough to require no more than two columns on the display screen.

```
AVAILABLE AMMUNITION TYPES ARE:

    1. ARM --- ARMOR PIERCING
    2. BIO --- BIOLOGICAL
    3. ILL --- ILLUMINATION (FLARE)
    4. FRA --- FRAGMENTATION
    5. GAS --- GAS/CHEMICAL
    6. INC --- INCENDIARY
    7. NUC --- NUCLEAR
    8. SMO --- SMOKE

ENTER THE # OR LETTER CODE FOR DESIRED AMMUNITION TYPE, OR
ENTER ONLY A CARRIAGE RETURN TO GET BACK -->
```

2. <u>Hierarchical input menus</u> are used when the number of legal entries exceeds two columns on the display screen.

```
IN WHAT TYPE OF EQUIPMENT ARE YOU INTERESTED?

      1.  CO --- COMBAT EQUIPMENT
      2.  AI --- AIR EQUIPMENT
      3.  TR --- TRANSPORTATION EQUIPMENT
      4.  EN --- ENGINEERING EQUIPMENT
      5.  etc.

--> CO
```

```
IN WHAT TYPE OF COMBAT EQUIPMENT ARE YOU INTERESTED?

      1.  ARM --- ARMORED EQUIPMENT
      2.  CMD --- COMMAND AND CONTROL EQUIPMENT
      3.  INF --- INFANTRY EQUIPMENT
      4.  etc.

--> ARM
```

Depending on the user's/operator's purposes, an additional frame could list specific pieces of armored equipment, or the user/operator might request a summary of available armored equipment or request some other processing function.

b. Input examples. Input examples are used to show the user/operator the correct format of legal entries, the correct content of legal entries, or both.

```
ENTER TIME IN HOURS, MINUTES, SECONDS AS "HH:MM:SS"

-->
```

```
ENTER TIME IN HOURS, MINUTES, AND SECONDS AS "HH:MM:SS"

     EXAMPLE:  12 SECONDS AFTER 1:32 PM
          --> 13:32:12

-->
```

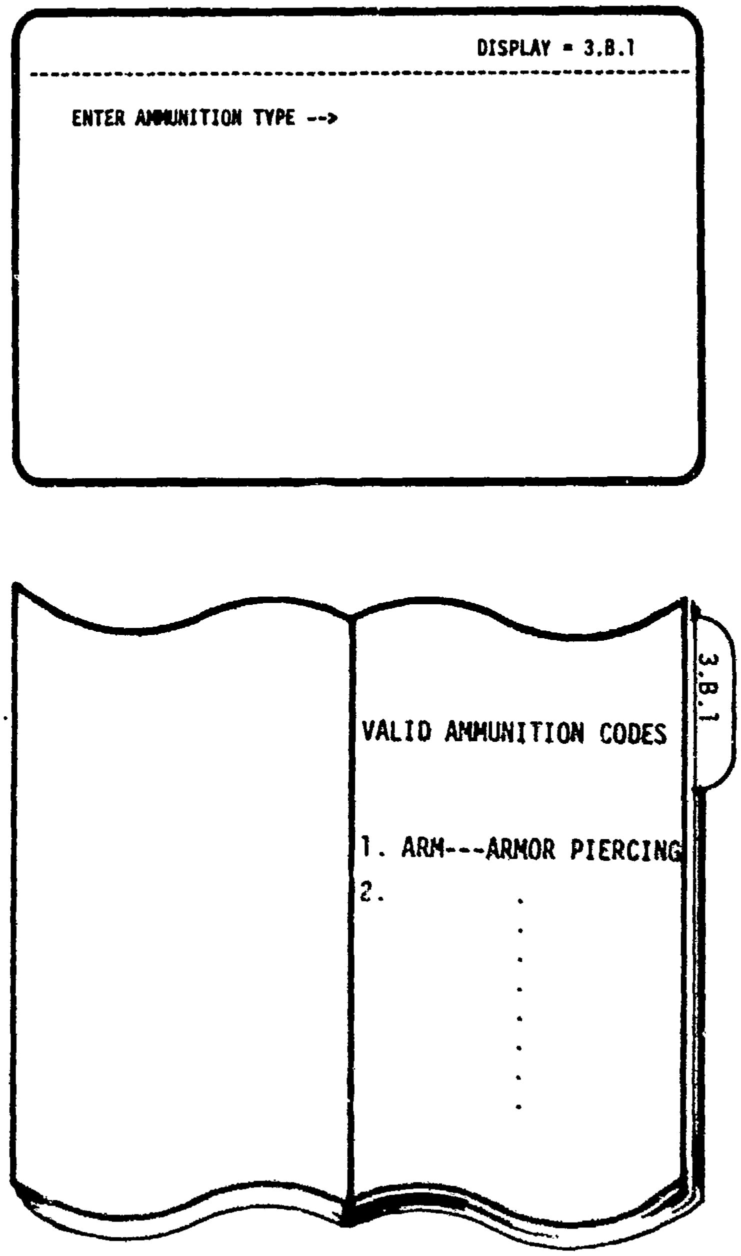
c. User-definable data entry codes. User-definable data entry codes permit the user/operator to define "shorthand" codes which represent lengthier data entry codes.

CODE	STANDS FOR
3H	303_FA_BD_HQ
4S	404_FA_BD_SD

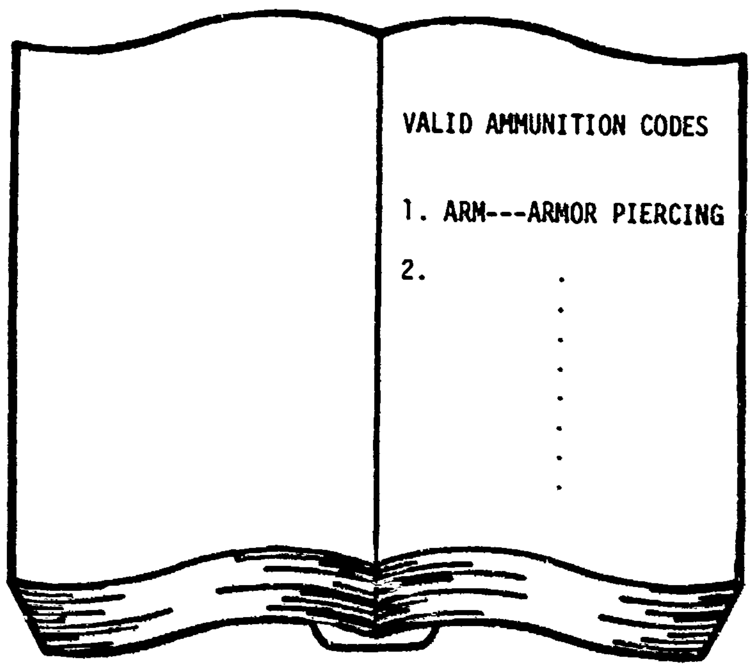
ENTER UNIT DESIGNATION -->303_FA_BD_HQ (VALID ENTRY CODE)

ENTER UNIT DESIGNATION --> 3H (VALID ENTRY CODE)

d. Display linkages. Display linkages direct the user from a particular data entry display to a section of a legal data entry code book or manual containing information on legal entries.



e. Code books and manuals. Code books and manuals provide detailed information on legal entries which cannot be placed on data entry displays.



3.1.5 RECOMMENDATIONS ON INFORMATION ON LEGAL ENTRIES

a. Table 3.1-1 presents general recommendations for using different methods for presenting information on legal entries depending on the particular application. Before deciding to use one or more of these recommendations, the reader should review the general recommendations in this section and the advisory comments on specific methods in Section 3.1.6.

Table 3.1-1 Method of Presenting Information on Legal Entries by Application Being Considered

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION					
	CRITICAL FORMAT	CRITICAL CONTENT	VALID BUT INCORRECT	RECALL DIFFICULTIES	NON-STANDARD TERMINOLOGY	LENGTHY CODES
INPUT MENUS						
•Simple	4	1	1*†	1*†	1	3
•Hierarchical	4	1	1*†	1*†	1	3
INPUT EXAMPLES						
•Format	1*	4	4	2	2	3
•Content	4	1*	4	2	2	1
USER-DEFINED CODES	4	2	2	2	1*	1*
DISPLAY LINKAGE	4	2	2	2	2	2
CODE BOOKS & MANUALS	2	2	2	2	2	2

*Recommended as 1st choice for standardization purposes.

†Use simple menus if no more than 2 columns are required, otherwise use hierarchical menus

b. Use the user/operator terminal to provide information on legal entries whenever possible.

b. Use the user/operator terminal to provide information on legal entries whenever possible.

c. Use the highest computer-to-terminal data transmission rates possible for displaying information on legal entries to the user/operator terminal. Minimum data transmission recommendations are presented in Table 3.1-2.

Table 3.1-2. Minimum Data Transmission Rates for Various Types of Legal Data Entry Information and Desired Display Times.

		DESIRED DISPLAY TIME		
Type of Legal Data Entry Information	Approximate Number of Characters	FAST (1 Second to put Data on Screen)	MODERATE (5 Seconds to put Information on Screen)	SLOWEST ACCEPTABLE (15 Seconds to put Information on Screen)
Format for a Data Entry Code	10	10 characters per second (about 100 baud)	2 characters per second (about 20 baud)	0.7 characters per second (about 7 baud)
Format and Example for Data Entry Code	50	50 characters per second (about 500 baud)	10 characters per second (about 100 baud)	3 characters per second (about 30 baud)
Short Data Entry Menu (About 4-8 Options in Menu)	200	200 characters per second (about 2000 baud)	40 characters per second (about 400 baud)	13 characters per second (about 130 baud)
Long Data Entry Menu; Single Page of Multi-Page Data Element Dictionary or Help File	1000	1000 characters per second (about 10,000 baud)	200 characters per second (about 2000 baud)	67 characters per second (about 670 baud)

d. Provide a means for the user/operator to prevent the system from displaying legal data entry information if he/she is experienced enough not to need it. (NOTE: this is particularly important if data transmission rates to the user/operator terminal are low.)

e. Make display formats for data entry identical to or compatible with formats used for output, scanning, and review of data items entered previously.

f. Provide illustrations and examples for legal data entry information whenever possible.

g. Provide definitions for all data entry codes.

h. Order the information on legal entries in a manner which is consistent with the way in which the user operator will use the information. Some examples of ordering methods are:

alphabetically (e.g., codes for designating countries); (2) SUBJECT ORDERING, in which codes are arranged by the subject with which they deal (e.g., codes for types of combat equipment).

i. Message formats are best designated by the use of all letter codes as opposed to a mixed alphanumeric code.

j. Always provide legal entries in codebooks or manuals (even when legal entry information is available at user terminals), for offline study and reference.

k. Provide duplicate code organization methods where different users/operators may desire to locate codes in different ways.

l. Provide duplicate legal entry information where users may use different terms to mean the same thing, for example:

COUNTRY NAME	CODE
RUSSIA	URS
⋮	⋮
SOVIET UNION	URS
⋮	⋮
UNION OF SOVIET SOCIALIST REPUBLIC	URS
⋮	⋮

m. When required data entries can be deferred, provide data validation software which signals omissions to the user/operator, permitting either immediate or delayed input of missing items.

n. When entry of a required data item is deferred, require the user/operator to enter a special symbol in the data field to indicate that the item has been temporarily omitted rather than ignored.

o. Automatically display currently defined default values in their appropriate data fields upon initiation of the data entry transaction. Do not expect the user to remember them.

p. In any data input transaction, allow the user/operator to replace a default value with a different entry, without changing the current default definition.

q. When useful default values for data entry cannot be predicted by system designers, provide a special transaction to define, change, or remove default values for each data entry field to the user/operator (or an authorized supervisor).

r. When a field delimiter must be used for data entry, adopt a standard character for that purpose: slash (/) is preferred.

s. When shorter than the maximum length of entry is allowed, distinguish between required and optional elements. Use dashes (---) to denote required length; use dots (...) to indicate additional elements.

t. In labeling data entry fields, use terms, codes, and/or abbreviations that appear in doctrinal literature or that are known to be familiar to the user/operator population. (See 6.2, Standard Terms, and 6.4, Abbreviations and Codes.)

3.1.6 ADVISORY COMMENTS ON METHODS FOR INFORMATION ON LEGAL ENTRIES

a. Input menus

1. Use information on legal entries on input menus where the users/operators of the system are likely to be inexperienced in the content of legal entries.

2. Use information on legal entries on input menus where input codes are long, only if the user/operator can benefit from positional coding in the menu.

3. Provide a method for experienced users/operators to stack commands to bypass input menus.

4. Do not use menus of legal entries where data transmission rates are low (below 1200 baud).

b. Input examples

When possible, use format and content examples in combination rather than using one or the other. (A content example illustrates the format; a format example makes the format more explicit.)

c. User-definable data entry codes

1. Use user-definable data entry codes where different users are likely to use different sets of data entry codes.

2. Use user-definable data entry codes where users/operators will use some codes more frequently than others.

d. Display linkages

Use display linkages where low computer storage capacity limits the amount of information which can be placed on data entry display menus and/or in HELP files.

e. Code books and manuals

1. Always provide legal entries in code books (even when legal entry information is available at the user terminal), for off-line reference and study.

2. Order the information on legal entries in a manner which is consistent with the way in which the user/operator will use the information. Some examples of ordering methods are:

(a) ALPHABETICAL ORDERING, in which codes are arranged alphabetically (e.g., codes for designating countries).

(b) SUBJECT ORDERING, in which codes are arranged by the subject with which they deal (e.g., codes for types of combat equipment).

(c) DISPLAY ORDERING, in which codes are arranged so that valid codes for a particular display are all in a single place in the code book or manual.

3. Provide duplicate code organization methods where different users/operators may desire to locate codes in different ways.

4. Provide duplicate legal entry information where users may use different terms to mean the same thing. For example:

COUNTRY NAME	CODE
RUSSIA	URS
⋮	⋮
SOVIET UNION	URS
⋮	⋮
UNION OF SOVIET SOCIALIST REPUBLICS	URS
⋮	⋮

3.2 Unburdening of Input

3.2.1 DEFINITION

Unburdening of input deals with ways to reduce the time and effort required to enter data and commands. It consists of capabilities within the system to eliminate or automate as many input tasks as possible, thereby minimizing the workload for users/operators.

3.2.2 APPLICATIONS FOR UNBURDENING OF INPUT

a. In command entry, when lengthy commands are typed in at the keyboard.

EXAMPLE: A tactical intelligence system uses commands such as PRINT, READ, EXECUTE, and TRANSFER to control the sequence of operations and the flow of data in the system. Forcing the user/operator to type in each command in its entirety, rather than permitting entry of abbreviations (e.g., Print, Read, Execute, Transfer), imposes an unnecessary burden in terms of the numbers of required keystrokes. The excess keystrokes also provide unnecessary opportunities for keying errors.

b. In repetitive command sequences.

EXAMPLE: An administrative system uses commands to identify the type of personnel transaction being entered (e.g., PROMOTION, PCS, LEAVE). Forcing the user/operator to enter the same command each time a particular transaction type is entered imposes an unnecessary burden, and creates additional opportunities for keying errors.

c. When the system has a large command set.

EXAMPLE: A supply control system has a large number of commands to control the various types of data entries and routine output reports. Forcing the user/operator to learn this command set in order to accomplish normal operations imposes an excessive memory burden.

d. In highly repetitive data entry tasks.

EXAMPLE: A command and control system requires certain types of data that do not change frequently over time (e.g., unit identifications), but which appear in most or all input and output formats. Forcing the user/operator to enter this relatively constant data each time such a format is used imposes an unnecessary burden.

e. In entry of lengthy data items.

EXAMPLE: To obtain the required accuracy in target coordinates, an artillery system requires the user/operator to enter 10-digit values for the target's latitude and longitude. Entering each value as a continuous 10-digit string imposes an excessive short-term memory burden.

f. In transcribing data from typed or printed forms.

EXAMPLE: A supply system requires the user/operator to type in data from standard printed forms. If the input format does not match the format of the printed form, the user/operator must search through the form for each data item, making the entry task unnecessarily complex.

g. <u>When only a few data fields must be entered into a preformatted display containing many fields.</u>

EXAMPLE: An artillery command and control system uses preformatted displays for all data input. Often, only two or three of the data fields must be used to provide the required entry. Forcing the user/operator to skip over unneeded fields reduces throughput and increases the probability of entering data in inappropriate fields.

h. <u>When data to be entered are received in nonstandard order.</u>

EXAMPLE: In a personnel system, the user/operator usually receives data on printed forms. Occasionally, however, data are received in unstructured, verbal communications. Forcing the user/operator to enter such data in a standard, fixed sequence imposes a burden on both the user/operator and the provider of the data.

i. <u>When varying formats describe the same data content.</u>

EXAMPLE: A date may be expressed in a variety of numeric and alphanumeric forms (e.g., 11/30/81 or 30 November 1981). Forcing the user/operator to use only one fixed form requires an unnecessary translation of all other forms to the required form.

j. <u>When data may be expressed in more than one unit of measurement.</u>

EXAMPLE: An artillery command and control system uses latitude and longitude for target coordinates and other location information. Forcing the user/operator to translate other measurement units (e.g., UTM) to latitude and longitude will reduce throughput and increase errors.

3.2.3 BENEFITS OF UNBURDENING OF INPUT

Unburdening of input will enhance overall system performance through improved user/operator performance by:

a. Reducing error rates, by minimizing:

1. Inability of the user/operator to maintain throughput requirements given the amount of command or data entry keystrokes necessary.

2. Probability of typographical error for each keystroke.

3. Judgmental or logical errors in defining complex sequences in commands which could have been "canned" by the users/ operators in previous executions of the same command sequence.

4. Probability of selecting commands or data entry options which are invalid given prior user/operator command or data entries.

5. Transcription errors in data or command input which could have been generated or obtained by the computer system.

6. Increased error rate associated with entry of redundant information for purposes other than verification and validation.

7. Misestimations from graphics displays.

8. Failure to accurately recall command or data entry content/ format presented on non-linked HELP displays.

b. Increasing system throughput rates, by minimizing:

1. Time required for entry of individual commands which require more keystrokes than necessary.

2. Time required to generate commands which could have been stored for subsequent use.

3. Time required to enter redundant commands in situations other than verification and validation processes.

4. Time required to correct errors resulting from inadequate attention to considerations of unburdening of input.

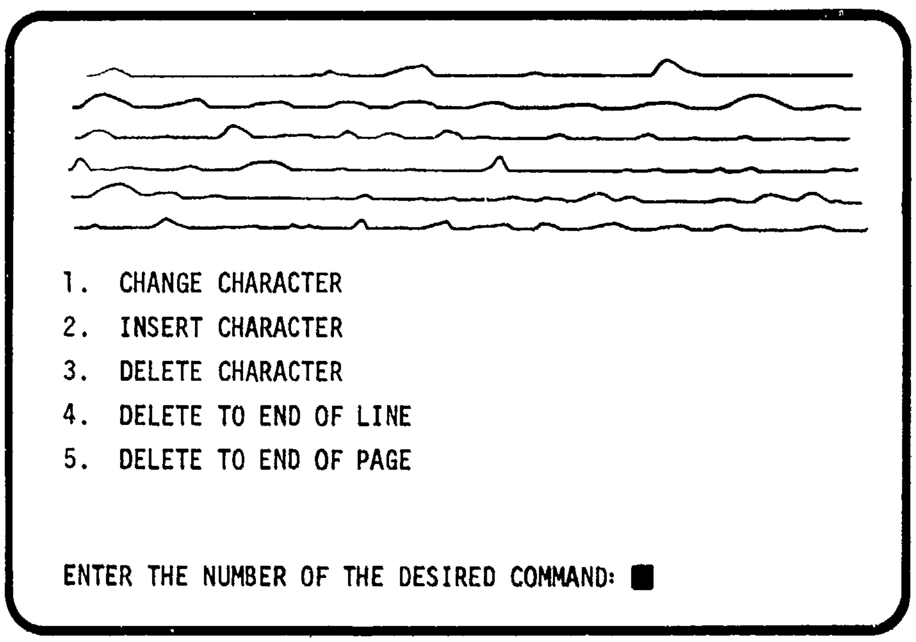
3.2.4 METHODS FOR UNBURDENING OF INPUT

a. Computer-propagated data. If a data item does not change often but is used frequently by the system (e.g., a unit identifier), it can be saved in a special area of storage and then retrieved automatically whenever needed.

b. Computer-generated data. When necessary data can be calculated from data entered previously, the machine can perform the calculations automatically and display the result when and where needed.

c. Hardware form scan. If typed or printed forms are prepared in a machine-readable font, hardware scanners can be used to input the data into the system.

d. Menus. Menus can be used to ease the burden on users/operators, both for entering commands and for entering data.



```
AVAILABLE AMMUNITION TYPES ARE:

    1.  ARM -- ARMOR PIERCING
    2.  BIO -- BIOLOGICAL
    3.  ILL -- ILLUMINATION (FLARE)
    4.  FRA -- FRAGMENTATION
    5.  GAS -- GAS/CHEMICAL
    6.  INC -- INCENDIARY
    7.  NUC -- NUCLEAR
    8.  SMO -- SMOKE


ENTER THE # OR LETTER CODE FOR DESIRED AMMUNITION TYPE, OR
ENTER ONLY A CARRIAGE RETURN TO GET BACK -->
```

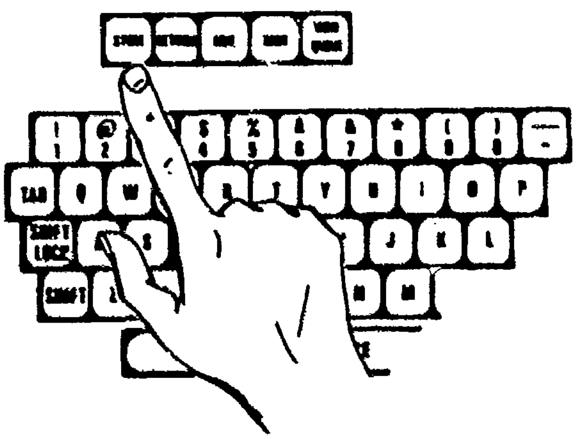
e. HELP files. HELP files can be used to explain the format, structure, and required content of lengthy data items. They can be used in similar fashion for large command sets.

```
UNIT I.D. CONSISTS OF THE FOLLOWING ITEMS OF INFORMATION:
      1.  COMPANY
      2.  BATTALION
      3.  BRIGADE
      4.  DIVISION

ENTER THESE ITEMS IN THE SAME ORDER AS LISTED ABOVE.
SEPARATE EACH ITEM FROM THE NEXT ITEM WITH A SLASH.
FOR EXAMPLE, B COMPANY OF THE 1st OF THE 64th AR
BATTALION, 3rd BRIGADE, 37 AR DIVISION WOULD BE:

                B/1-64  AR/3/37 AR

ENTER YOUR UNIT I.D.:■
```

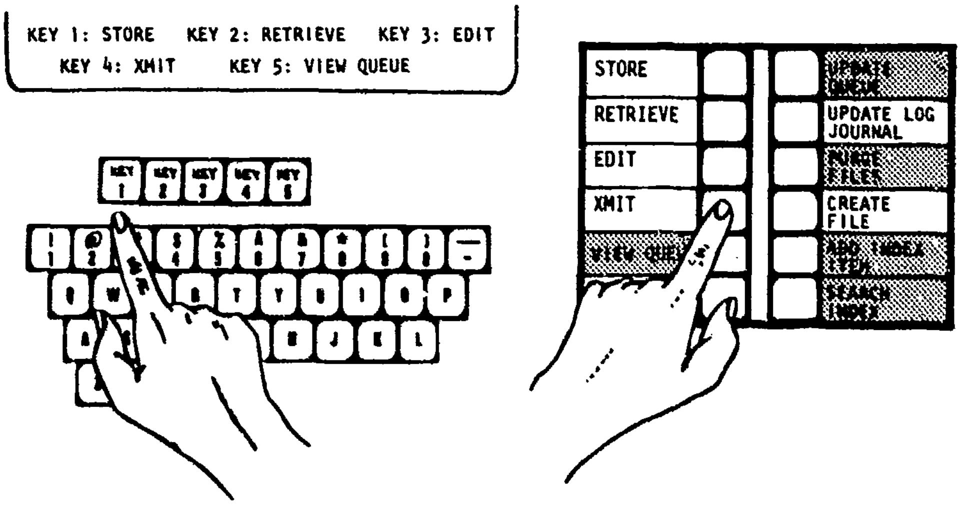
f. Prespecification of data entry progression. Software can be provided to permit the user to specify the sequence in which data items will be entered.

```
THE "UNIT DATA" FORMAT CONTAINS THE FOLLOWING DATA ITEMS:
   1.  UNIT I.D.               6.  MORALE
   2.  DTG                     7.  TRANSPORT
   3.  CDR                     8.  READINESS
   4.  PARENT UNIT             9.  WEAPONS
   5.  PERSONNEL STRENGTH     10.  AMMUNITION

ENTER THE NUMBERS OF THE DATA ITEMS YOU WANT TO USE, IN
THE ORDER YOU WANT TO USE THEM.  USE COMMAS TO SEPARATE
THE NUMBERS.  FOR EXAMPLE:

           1, 4, 7, 10, 5

--> ■
```

g. Fixed function keys. Fixed function keys allow the user/operator to press a special key on a terminal keyboard to indicate to the computer that a particular operation should be performed. The keys are labeled with the operations which the system is to perform.



h. Variable function keys. The user/operator presses a special key to indicate to the computer that a particular operation should be performed. The variable function key may perform different functions, depending on what kind of activity the user/operator is performing. Usually the specific effect of pressing a given variable function key is indicated by a brief menu presented on the terminal or on transparent key label overlays or underlays.



i. Cursor control for field specification. The user/operator moves the cursor to the first data entry position of the desired data field. The system recognizes the cursor position and acknowledges that the data field has been selected.

```
USER CODE NUMBER: ______-__-___ ID NUMBER: _____-__
CHARGE CODE: ___-__/__ DATA FILE DESIRED:█____:__:__
ACTIVITY:  STORAGE:__ RETRIEVAL:__ EDITING:__
OPTIONS:____ ____
        ____ ____
        ____ ____
        ____ ____
HARD COPY DESIRED? (Y/N):__

-----------------------------------------------------------
ENTER DATA FILE DESIRED
```

j. Graphics tablet for field specification. The user/operator uses the stylus of a graphics tablet to indicate the desired data field. The system recognizes the stylus input, positions the screen cursor to the first entry position of the data field, and acknowledges that the data field has been selected (as shown immediately above).

k. Touch screen for field specification. This method is analogous to "i" and "j" above, except that the user/operator touches the face of the display screen to indicate the desired data field.

1. User-definable data entry codes. User-definable data entry codes permit the user/operator to define "shorthand" codes which represent lengthier data entry codes.

CODE	STANDS FOR
3H	303_FA_BD_HQ
4S	404_FA_BD_SD

ENTER UNIT DESIGNATION --> 303_FA_BD_HQ
(VALID ENTRY CODE)

ENTER UNIT DESIGNATION --> 3H (VALID ENTRY
CODE)

m. On-screen form analogs. The preformatted input display provides a "fill in the blanks" approach, using the same format as a corresponding printed form.

n. Machine transgeneration. The machine incorporates software to translate a data entry in one unit of measurement to some other unit of measurement. For example, location data entered as latitude-longitude could be translated automatically to UTM.

o. Format recognition. In many situations, the machine can recognize data on the basis of its format. For example, when asking for a date, the forms "January 21 1981" and "21 Jan 81" are sufficiently distinctive that the machine can interpret them accurately (and translate them to another form as necessary).

p. Self-prompted input. Software can be provided to permit the user/operator to type in the name of a function to be performed and the data field labels and corresponding data items. This capability provides an alternative to filling in preformatted displays. For example, rather than calling up a format and then skipping past multiple unneeded fields, a user/operator might enter:

```
RUN XYZ, DATE = JAN 21 81, TGT = ALPHA,
AUTH = HPY33
```

The system would then execute function XYZ, using the data provided and default or previously entered values for all data fields not entered by the user/operator.

q. Command macros. In some situations, the user/operator uses the same sequence of commands and associated parameters frequently (e.g., to generate a routine status report). Command macros permit the user/operator to define such sequences as "command macros," to give each macro a unique name, and then to run the macro simply by entering its name.

```
DEFINE REPORT1

GET DAILY.STATUS
MERGE NEW.DATA
RUN DELETE.LOSSES
RUN ADD.GAINS
RUN ADD.RETURNS
EDIT OLD.DATA
PRINT DAILY.STATUS
SAVE DAILY.STATUS
END REPORT1

RUN REPORT1
```

3.2.5 RECOMMENDATIONS ON UNBURDENING OF INPUT

a. Table 3.2-1 presents recommendations for using particular methods for unburdening of input, depending on the specific data entry application. Before deciding to use one or more of these methods, the reader should review the general recommendations that follow, and consult the advisory comments on specific methods contained in Section 3.2.6.

Table 3.2-1. Method of Unburdening of Input by Type of Data Entry Applications

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	APPLICATION									
METHOD	LENGTHY COMMAND STRINGS	REPETITIVE COMMAND SEQUENCES	LARGE COMMAND SETS	REPETITIVE DATA	LENGTHY DATA ITEMS	TYPED/PRINTED FORMS	SPARSELY FILLED FORMS	DATA IN NON-STANDARD ORDER	VARYING FORMS FOR SAME DATA	VARYING MEASURES FOR SAME DATA
COMPUTER PROPAGATED DATA	4	4	3	1*	3	3	3	3	3	3
COMPUTER GENERATED DATA	2	4	3	1	3	3	3	3	2	3
HARDWARE FROM SCAN	4	4	3	4	4	1	3	4	4	4
MENUS	3	3	1*	4	2	4	4	4	4	4
HELP FILES	3	3	1	3	1	3	3	3	3	3
PRESPECIFICATION OF DATA ENTRY PROGRESSION	4	3	3	3	3	3	1	1*	3	4
FIXED FUNCTION KEYS	4	3	2	2	4	4	3	4	4	4
VARIABLE FUNCTION KEYS	4	3	2	2	4	4	3	4	4	4
CURSOR CONTROL FOR FIELD SPECIFICATION	3	3	3	3	3	3	2	2	4	4
GRAPHICS TABLET FOR FIELD SPECIFICATION	4	4	3	3	4	3	2	2	4	4
TOUCH SCREEN FOR FIELD SPECIFICATION	4	3	3	3	4	3	2	2	4	4
USER-DEFINABLE DATA ENTRY CODES	1*	1	3	3	1*	3	3	3	3	3
ON-SCREEN FROM ANALOGS	3	3	4	4	3	1*	3	4	4	4
MACHINE TRANSGENERATION	3	3	3	3	3	3	4	1	2	1
FORMAT RECOGNITION	4	4	4	4	4	3	3	4	1	1
SELF-PROMPTED INPUT	4	4	4	4	4	3	1*	1	3	3
COMMAND MACROS	1	1*	3	4	4	4	4	4	4	4

*Recommended as 1st choice for standardization purposes.

b. Standardize data entry procedures to the maximum extent feasible. Make formats, data item locations, grammatical structures, and input modes as consistent as possible throughout the system's functions and workstations.

c. Any time the user/operator presses any key, project the character or label associated with that key on the display. Exceptions:

   1. Each character of a password or other system security item may be replaced with a standard character--preferably "x."

   2. When cursor control keys are pressed, the corresponding movement of the cursor eliminates the necessity for a symbol to appear on the display.

d. In systems employing typed-in commands, allow the user/operator the option to enter a series of commands as a single string. Separate individual commands in the string by a standard delimiter--preferably the virgule (/).

e. When a command or data string has been entered, and the system finds missing or incorrect items in the string, do not require the user/operator to re-enter the entire string. Provide software to prompt only for the missing or incorrect portion of the string.

f. Do not require the user/operator to remember data entered on previous display frames. If previously-entered data is necessary, present the needed data as part of the current frame.

g. Do not develop data entry situations that force the user/operator to switch frequently from one input mode to another (e.g., switch back and forth between light pen to keyboard). To the maximum extent possible, allow the user/operator to remain with one input mode throughout a transaction.

h. When a user's/operator's workstation incorporates more than one display device (e.g., multiple CRT screens), allow the user/operator to use the primary display for data entry.

i. To the maximum extent possible, allow the user/operator to enter data at his/her own pace.

j. After the user/operator has completed a data entry task, provide the option to review and verify the complete set of newly-entered data.

k. If the user/operator must enter a long list of data items, provide the option to enter them in any desired order.

l. When the data to be entered are alphabetic, do not restrict the alphabetic character set (e.g., do not prohibit the use of "Q" and "Z").

m. Always require the user/operator to take an explicit action to enter a command or data string. An ENTER key is appropriate for this purpose. Do not allow an unrealted action (such as returning to a menu of control options) to signify entry of data just keyed into a display.

n. When a key is used to explicitly indicate that just-keyed data are to be accepted by the computer for checking and/or processing, label the key ENTER. Do not label this key CR, RETURN, or XMIT.

o. To the maximum extent possible, keep the length of individual data items to 7 characters or less. This avoids excessive burden on the user's/operator's memory. Exception: text material.

p. If individual numerical data items must be longer than 7 characters, allow the user/operator to enter the item in groups of three or four digits.

q. Do not force the user/operator to enter leading zeros, leading blanks, or other characters merely for formatting purposes. Provide software to accomplish right or left justification and decimal point alignment of tabular data entries.

r. In tabular data formats, left justify column headings, especially if data items in the column vary in length.

s. Locate input prompts in a consistent screen location, preferably in the bottom quarter of the screen.

t. Use the colon (:) to denote a prompt (e.g., ENTER NAME:_____). On the display screen, use the colon only for this purpose. Exception: extended text.

u. For input prompts, indicate the maximum number of characters permitted, the spacing, and the syntax. Example:

```
USER ID:_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
TERMINAL ID:_ _ _/_ _ _ _/_ _
PASSWORD:_ _ _ _ _ · _ _ _
```

v. Use a separate prompt for each data item:

```
USER ID:__________________
TERMINAL ID:___/____/__
PASSWORD:_____-___
```

Do not combine prompts for multiple data items:

```
ENTER USER ID, TERMINAL ID, AND PASSWORD:

__________________
___/____/__
_____-___
```

w. If the user/operator must interact witn a network of systems, provide software to translate one system's data formats and structures to another's. Do not force the user/operator to perform such translation tasks.

x. Whenever possible, use source data entry, i.e., enter directly from incoming messages, rather than recording the data on paper forms and then transcribing from the forms into the system.

y. Design each input display frame for a specific task or subtask. Then present on that frame only the information actually required for that input task or subtask. Do not provide "contextual" or "supplemental" information that is not actually needed.

z. Do not "pack" an input display frame with data items, merely to reduce the number of frames required for a unit of work.

aa. Provide a capability to require the user/operator to confirm entries of critical commands or data. For example:

```
YOU ENTERED "DELETE WRG.DAT"
EXECUTION OF THIS COMMAND WILL DELETE THE WHOLE FILE
NAMED WRG.DAT

    1. PRESS CONFIRM TO EXECUTE THE COMMAND TO
       DELETE WRG.DAT
    2. PRESS ENTER (or some other key) TO CANCEL THE
       COMMAND TO DELETE WRG.DAT
```

```
YOU ENTERED "DELETE WRG.DAT"

EXECUTION OF THIS COMMAND WILL DELETE THE WHOLE FILE
NAMED WRG.DAT

     1. ENTER (Y)ES TO EXECUTE THE COMMAND TO DELETE
        WRG.DAT

     2. ENTER (N)O TO CANCEL THE COMMAND TO DELETE
        WRG.DAT
```

bb. When the user/operator is required to confirm entry of multiple commands or multiple data entries, ensure that the confirming action results in entry of all the items regardless of the cursor's location on the screen at the time confirmation is made.

cc. Do not permit deletion of data items by direct command entries without first displaying the value to be deleted.

dd. Do not permit changes to data items by direct command entry without first displaying the value to be deleted.

ee. Except for text, accomplish data entry and changes by direct replacement of characters. Use keyed inputs to replace underscores or previous entries (including default values) in data fields.

ff. When possible, choose special characters used in data entry (@, *, +, #, etc.) so that the user/operator will not have to shift between upper case and lower case on the keyboard.

gg. In repetitive data entry tasks, perform data validation for each transaction and allow the user/operator to correct errors before beginning the next transaction.

hh. In multiple-entry transactions provide item-by-item error checking and validation only as an option selectable by the user/operator.

ii. Allow the user/operator to accomplish acceptance of default values by a simple action, such as by pressing a CONFIRM or TAB key.

jj. When a user/operator edits or updates a data item that is stored in more than one file, provide automatic updating of each file containing that item. Exception: history files.

kk. Any time the user/operator enters multiple data items in a single transaction, provide the options to RESTART, CANCEL, or BACKUP to change any item before taking a final ENTER action.

ll. When a delimiter is needed to separate the subfields of a data item, use the virgule (/). Exceptions: well-known items such as telephone numbers (e.g., (703) 385-0190) and social security numbers (e.g., 374-36-9267).

mm. When a dimensional unit (e.g., $, mph, km, gal) is consistently associated with a particular data field, display it as part of the data field label (e.g., FUEL:_ _ _ _ _ _ GAL). Do not require the user/operator to enter it each time the data item is entered.

nn. When alternative dimensional units are acceptable (e.g., mph, kph), provide space in the data field for the unit descriptor.

oo. Design input formats to be identical or compatible to corresponding output formats.

pp. When user/operator-computer dialogs involve prompting, prompt data entries explicity by displaying data field labels and/or associated user/operator guidance messages.

qq. When some entries in a multiple entry transaction are optional, arrange the optional items after the mandatory items. Indicate OPTIONAL in the prompts for optional items. For example:

```
ENTER WEAPON TYPE:_ _ _ _ _ _ _ _ _ _
ENTER MAX RATE (OPTIONAL):_ _ _ _ _ _
ENTER SHELL TYPE (OPTIONAL):_ _ _
```

rr. Provide multiple paths through a transaction, to accommodate experienced as well as inexperienced users/operators. For example, in a menu-oriented system, allow inexperienced individuals to work through a sequence one menu at a time. However, provide the capability for experienced users/operators to enter a command stack and bypass the menu sequence.

ss. When useful default values cannot be predicted in advance, provide a capability for authorized personnel to use a special transaction to define, change, or delete default values for each data field.

tt. Software protect areas of display not used for data entry (e.g., data field labels, blank spaces used for formatting purposes) to prevent inadvertent character entry into such areas.

uu. Make the predefined cursor HOME position consistent for all display frames.

vv. Do not require the user/operator to re-enter data items that have not changed since the last transaction. Also do not require the user/operator to enter data items already available to the computer (e.g., the current time or date).

3.2.6 ADVISORY COMMENTS ON METHODS FOR UNBURDENING OF INPUT

a. Computer-propagated data

1. When the computer inserts data into a field from a previous entry or from already available sources (e.g., the system clock), display the data as a default value.

2. Automatically skip the cursor past data fields filled by computer-propagated data.

3. If the user/operator is permitted to alter the contents of data fields automatically filled by computer-propagated data, provide a TAB BACK function key. Pressing this key would move the cursor backward to the first character entry position of the previous data field.

b. Computer-generated data

1. When the computer inserts data into a field that it calculates from previously entered data, display the calculated data as a default value.

2. Automatically skip the cursor past any data field filled by computer-generated data.

3. Provide the capability for the user/operator to indicate his/her desire to change a computer-generated data value. However, before permitting the value actually to be changed, display the basis for the computer calculations. For example, if DISTANCE were calculated from MPH and TRAVEL TIME, and the user/operator indicated a wish to change the value of DISTANCE, the machine might respond:

```
DISTANCE = MPH X TRAVEL TIME
75 MILES = 30  X 2.5 HOURS

IF YOU WANT TO CHANGE DISTANCE, YOU MUST ALSO CHANGE
MPH OR TRAVEL TIME.  WHAT DO YOU WANT TO DO?

     1.  KEEP THE DATA SHOWN ABOVE
     2.  CHANGE MPH (MACHINE WILL CALCULATE DISTANCE)
     3.  CHANGE TRAVEL TIME (MACHINE WILL CALCULATE
         DISTANCE)


ENTER YOUR CHOICE: █
```

c. Hardware form scan

1. Make hardware form scanning a separate transaction. Do not require the user/operator to leave an interactive terminal to do form scanning during an interactive session if this can be avoided.

d. Menus

1. If at all possible, do not require the user/operator to move the cursor to a data item in order to select that item from a menu. Instead, number each item and allow the user/operator to enter the number of the selected item. Also, provide the option to enter codes composed of the initial characters of the options. For example:

```
THE AVAILABLE OPTIONS ARE:

     1.  (RE)TRIEVE DATA
     2.  (ST)ORE DATA
     3.  (ED)IT DATA
     4.  (AD)D A FILE
     5.  (DE)LETE A FILE




ENTER DESIRED OPTION -->
```

2. If position designation must be used to indicate menu selection, use a light pen rather than other devices (e.g., cursor keys, trackball, joystick) to select the desired option.

3. Provide a capability for users/operators to by-pass a well-known sequence of menus by entering a single string of menu options. Command stacks are particularly appropriate for this purpose.

e. HELP files

1. Provide a HELP file for every transaction. Each HELP file should contain an explanation of each data field used in the transaction, keyed to that field.

2. Provide HELP files only as options selectable by the user/operator. Provide a HELP function key, or allow the user/operator to enter a special character in the data field (preferably "?") to select HELP.

3. When the user/operator selects HELP, present only the explanatory information appropriate to the particular data field currently being addressed.

4. If at all possible, provide at least two levels of HELP information--the first level to contain a brief reminder of the purpose and required contents of the data field, the subsequent level(s) to contain increasingly detailed information. In the last level of HELP, advise the user/operator to seek guidance from a specific manual or code book or to confer with a supervisor if the explanation is not sufficient to remove his/her confusion.

5. Express HELP information in the user's/operator's functional language (e.g., explain artillery data fields in artillery language), not in the language of computer designers, manufacturers, or programmers.

f. <u>Prespecification of data entry progressions</u>

1. Allow the user/operator to describe the sequence of data entries in a table of his/her own construction. For example:

INPUT FORMAT

```
USER CODE NUMBER: ______-__-___ ID NUMBER: _____-__
CHARGE CODE: ___-__/__ DATE FILE DESIRED: ______:__:__
ACTIVITY: STORAGE:__ RETRIEVAL:__ EDITING:__
OPTIONS:____ ____
        ____ ____
        ____ ____
        ____ ____
HARD COPY DESIRED? (Y/N):__
```

USER'S/OPERATOR'S SPECIFICATION TABLE

1. USER CODE NUMBER
2. DATA FILE DESIRED
3. ACTIVITY: EDITING
4. OPTIONS

In this example, the user/operator constructs the specification table using a special transaction provided for this purpose. Then, when the input format is displayed, the system retrieves the specification table and uses it to position the cursor only to those fields listed in the table (interpreting item 3 to mean that this user/operator will only edit data).

g. Fixed function keys

1. Label fixed function keys accurately (e.g., ENTER, not CR or RETURN, to signal the computer to enter data input to the screen), especially when users/operators are likely to be unsophisticated.

2. Group fixed function keys according to purpose and type of data.

3. Provide fixed function keys for commands that are entered frequently.

4. If fixed function keys are enabled at some points in system operations and disabled at other points, provide a light behind the key that is on when the function is enabled.

5. Do not use fixed function keys if the command set is larger than about 30 commands, or if commands require multiple parameters.

6. Fixed function keys are particularly appropriate for simple transactions that are performed frequently (e.g., NEXT PAGE, PREVIOUS PAGE, HELP, RE-BOOT, CONTINUE).

7. Particularly when tabular formats are used, provide a DITTO key when data are duplicated frequently.

8. Display the purpose of each fixed function key at all times, whether the key is enabled or disabled at any given point in system operations. The best method for this is to mark the function key directly; alternatively, the label can be displayed beside the key.

9. Use fixed function keys for particularly critical inputs, to avoid spelling or syntax errors and to minimize input time.

10. Do not force the user/operator to press more than one fixed function key (e.g., SHIFT or ENABLE plus the function key) to perform a simple operation. Exception: If unintentional activation of a fixed function key would have serious consequences for system or tions or system output, do require the user/operator to p two keys simultaneously to activate that function.

11. Do not assign different functions to a single fixed function key, with the applicable function depending on the particular point in system operations. Use variable function keys for such purposes. (See the following section of Advisory Comments.)

h. Variable function keys

1. When the function of a variable function key depends on the particular point in system operations, provide a backlighted label for each function assigned to the key. Turn on the light for the currently available function, and turn off the light(s) for disabled functions.

2. Use software to disable variable function keys not needed for current tasks. Do not provide mechanical overlays for this purpose.

3. To the maximum extent feasible, place function labels on, in, or beside variable function keys, rather than listing options on the display screen and encoding the function keys numerically or alphanumerically.

i. Cursor control for field specification

1. On initial appearance of an input display, automatically place the cursor at the first character position of the first data field.

2. Use a pointing device (e.g., light pen) rather than discrete or continuous devices (e.g., keys, trackball, joystick) to move the cursor to a desired data field.

3. If input formats contain data fields that are not used for every transaction, arrange these fields behind those that are used most frequently.

4. Signal completion of a position designation action by immediate feedback to the user, normally by appearance of the cursor at the first input character position of the selected data field.

5. Do not use cursor control for field specification by the user/operator if other methods are available (e.g., pre-specification of data entry progressions) for sparsely filled forms. (See Table 3.2-1.)

j. Graphics tablet for field specification

1. The area of a tablet reserved or specified as a surrogate display screen must be at least as large as the actual screen.

k. Touch screen for field specification

1. Touch screen for field specification is not an optimal method for applications that require concurrent use of other methods (e.g., keyboard) to complete an entry. Use touch screen methods when entries are selected from menus.

l. User-definable data entry codes

1. Use user-definable data entry codes to permit users/operators to define "shorthand" codes that will reduce the length of command or data strings.

2. Use user-definable data entry codes when different users/operators are likely to use different sets of data entry codes.

3. Use user-definable data entry codes when users/operators are likely to use some codes more frequently than others.

m. On-screen form analogs

1. To the maximum extent possible, structure on-screen form analogs to resemble the typed or printed paper forms that they represent. This includes layout as well as sequence of data items.

2. Use implicit cues in on-screen analogs to supplement explicit labels; use special characters (e.g., underscores) to indicate field and subfield lengths. For example:

```
TIME:__H __M __S
```

n. Machine transgeneration

1. Use machine transgeneration whenever data must be converted from one unit of measurement to another (e.g., gallons to liters, kilometers to miles).

o. Format recognition

1. Use format recognition whenever different forms of the same data are acceptable to the general population (e.g., Jan 21, 1981; January 21, 1981; 21 JAN 1981; 21 January 1981; 1/21/81).

2. When the format of a data entry is critical to machine entry, provide formatting examples on-line. For example:

```
ENTER DATE AS DDMMYY

EXAMPLE:  21 JAN 1981 WOULD BE ENTERED AS 210181

ENTER DATE: █
```

p. Self-prompted input

1. Use self-prompted input when only a few data items are to be entered on a form containing multiple items.

2. Do not restrict the sequence in which self-prompted data items are entered; provide software to arrange the entered items in the order required by the system.

q. Command macros

1. Use command macros when users/operators frequently must enter the same sequence of commands (e.g., generating a fixed format weekly report).

2. Allow the user/operator to construct command macros which can query the user/operator for parameters whose values change over time.

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3.3 Interrupts and Work Recovery

3.3.1 DEFINITION

Interrupts and work recovery refer to operator activity halts which are correctable through the user/operator interface. An activity halt may occur when a user/operator is instructed by supervisory personnel to perform a different task and must interrupt the current transaction, when hardware failure occurs or when the user/operator must interrupt current operations to respond to an incoming message. The user/operator interface should be designed to provide assistance to the user/operator when original tasks are resumed; work recovery needs to be immediate and unencumbered.

3.3.2 APPLICATION AREAS FOR INTERRUPTS AND WORK RECOVERY

Methods for dealing with interrupts and work recovery are particularly appropriate to the following activities:

a. Reacting to high-priority messages and tasks.

EXAMPLE: A user/operator may receive an incoming message which requires immediate attention or may be assigned a task which takes precedence over the task at hand. As a result, a halt in operator activity occurs.

b. Recovery from total system failure.

EXAMPLE: Should the external mobile power supply of the van-mounted system fail, the user/operator faces the task of re-starting and re-initializing the entire system. Data items in process when the power fails which include command strings and updates to the data base will be lost if they are in "scratch pad" or volatile memory.

c. Where system configuration/reconfiguration is required.

EXAMPLE: In a communication system, the user/operator prior to conduct of a mission will assign communication channels and hardware to link his/her system into the communication network. Additionally, during conduct of a mission, terminals or items of equipment may be affected by hostile action or simple failure. In this case, the user/operator will restore the communication network by reconfiguring with either existing equipment or bringing standby units on-line.

d. During system and initialization startup.

EXAMPLE: In an artillery system, after the system has been physically relocated and devices powered up and ready to be tested, system startup and initialization are required. The user/operator will perform checks on his/her equipment, run diagnostics, and use the daily orders and look-up tables to assign peripherals and communication channels in order to configure equipment into the system.

e. Upon message/communication receipt.

EXAMPLE: While processing a current task, the user/operator is notified of the receipt of an incoming message. If the user/operator chooses to stop the current task in response to the incoming message, the information at hand will be lost, unless recovery procedures are provided.

f. Where more than one operating task may be carried on at the same time.

EXAMPLE: On an intelligence system, a user/operator instructs the system to generate a list of all weapon systems by type located within a specified geographical area. The user/operator knows from experience that the task will consume appreciable time. The job is, therefore, designated as a background task, and the user/operator continues processing incoming messages in the foreground. When the machine completes the background task, it notifies the user/operator of that completion by appropriate signals.

3.3.3 BENEFITS OF PROVIDING INTERRUPT AND WORK RECOVERY FEATURES

Providing system design features to permit interrupts and facilitate work recovery:

a. Reduces error rates, by minimizing:

   1. Probability of error due to requirement for entering redundant information.

   2. Increased probability of error associated with entry of commands and data which are only rarely used.

   3. Attempts to complete a partially finished task without provision of the appropriate task-contextual cues.

b. Increases system throughput rates, by minimizing:

   1. Requirements for redoing work lost during system failure.

   2. Requirements for redoing work interrupted by higher-priority tasks.

   3. Requirements for the system to reprocess information when an active task was interrupted because of system failure or the presence of higher-priority tasks.

   4. Necessity for reevaluating the context in which an interrupted task was being performed.

   5. Lack of an ability to perform any operations during conditions of partial system failure.

   6. Lack of available reference materials to reestablish full operational status following restart.

   7. Excess time required to restart system after relocating it or its elements.

   8. Time required to specify detailed system restart instructions.

   9. Time required to reenter data which was lost due to interruption or system failure.

c. Reduces user/operator frustration and irritation, by minimizing:

   1. Requirements for entry of redundant information.

   2. Destruction of partially completed tasks on receipt of high-priority information.

d. <u>Reduces data base integrity compromises</u>, by minimizing the loss of information being processed or entered at the time of system failure or interruption of user/operator activities by higher priority tasks.

e. <u>Reduces compromise of system or network configuration integrity</u>, by minimizing the requirement to perform detailed system- and/or network-configurational command entry at each system restart.

3.3.4 METHODS FOR DEALING WITH INTERRUPTS AND WORK RECOVERY

a. Alternative sensory channels. If a system incorporates alternative sensory channels (e.g., CRT, hardcopy, and/or computer-generated speech output; keyboard, light pen-menu, and/or voice input) then the channel used for secondary purpose can be used for interrupt situation.

EXAMPLE: In a tactical command and control system, the normal display is a CRT screen. If the CRT fails, operations can continue (in a degraded mode) if normal CRT outputs can be presented on a nearby printer or via computer-generated speech.

EXAMPLE: In an intelligence processing system, the user/operator is performing a routine transaction when a priority message arrives. A bell sounds on the console and a computer-generated voice announces the presence of the priority message in the queue.

b. Multiple displays. When a system incorporates multiple displays at a single workstation, the display not currently in use can provide backup for interrupts and work recovery.

EXAMPLE: A logistics system employs two alphanumeric displays to provide simultaneous presentation of extensive data required for complex transactions. If one CRT fails, system software can enable continued operations by using the remaining display and scrolling techniques, coupled with special "format scrambling" procedures to present associated data items on the same display frame.

EXAMPLE: An intelligence system uses a terminal incorporating two alphanumeric displays. If a high priority message arrives, the system displays a warning message in reserved areas of both displays. The screen not presently receiving data then is used to deal with the priority message. Upon completion of the priority transaction, this screen is restored, and the routine transaction is resumed on the original screen.

c. Retention of interrupt state. When an interruption occurs in normal operations, the system automatically stores data and commands related to the current transaction.

EXAMPLE: A user/operator is working on a routine message in an artillery command and control system when a priority message arrives. The system automatically halts the current transaction, immediately places an alerting message in the warning or error message area on the display screen, saves all data and commands from the in-progress transaction, clears the screen, and then displays the priority message.

EXAMPLE: A user/operator is performing routine transactions in a personnel accounting system when external power suddenly fails.

An on-board emergency power source cuts in automatically, providing power enough for emergency software routines to save the entire contents of volatile storage and displays on a disk pack.

d. Automatic file naming and storage. Throughout routine operating sessions, the system periodically performs an automatic "save" of all data and commands generated since the last such save. It automatically generates a file name linked to the user's/operator's ID, then saves all data, results, and commands active at the time of the save. Each new periodic save purges the preceding file.

EXAMPLE: A user/operator is working with the Ground Order-of-Battle (GOB) File in an intelligence system. Once an hour, the system generates a file name linked to this individual (e.g., "GOB.SMITH.9267) and saves the current GOB in a file with that name, along with the current contents of the display screen and any commands presently active. It does this without Smith's participation or even knowledge.

e. Standard, editable start-up configurations. When normal operations are interrupted for any reason, software routines are used to guide resumption of operations. Such routines are provided for each workstation as needed, and for the system as a whole.

EXAMPLE: A tactical command and control system has just completed a routine move. The system has been powered up and diagnostic routines have run successfully. The last step in the diagnostic routine is to invoke startup software. This software guides the user/operator through the steps required to establish the communication network; identify each terminal by type, function, and security status; identify user groups; and perform any other procedures necessary to prepare for normal operations.

3.3.5 RECOMMENDATIONS FOR INTERRUPTS AND WORK RECOVERY

a. Table 3.3-1 presents general recommendations for using particular methods for interrupts and work recovery. Before deciding on specific methods, the reader should review the recommendations presented in this section and the advisory comments on interrupts and work recovery in Section 3.3.6.

Table 3.3-1. Method for Dealing with Interrupts and Work Recovery by Application

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION: HIGH-PRIORITY MESSAGES AND TASKS	TOTAL SYSTEM FAILURE	SYSTEM CONFIGURATION/ RECONFIGURATION	SYSTEM INITIALIZATION/ STARTUP	MESSAGE COMMUNICATION/ RECEIPT	FOREGROUND/ BACKGROUND PROCESSING
ALTERNATIVE SENSORY CHANNELS	1*	4	4	4	2	1*
MULTIPLE DISPLAYS	1*	4	4	4	1	1
RETAIN INTERRUPT STATE	1*	1*	4	4	1*	4
AUTOMATED FILE NAMING AND STORAGE	2	4	4	4	1	4
STANDARD, EDITABLE STARTUP CONFIGURATIONS	4	4	1	1	4	4

*Note: For high-priority messages and tasks, no method is indicated for standardization purpose because all three "best" methods should be used. (See Section 3.3.6, Advisory Comments.)

*Recommended as 1st choice for standardization purposes.

b. Provide automatic safeguards to prevent errors from entering system data bases during system failures.

c. If entries made during one transaction will be relevant to a subsequent transaction, require the system to "remember" these entries if failure occurs during the subsequent transaction.

d. If work is halted by a higher-priority message or task, provide the capability to restore the system precisely to the point at which the original work was interrupted.

e. During entry of multiple data items, allow the user/operator to interrupt his/her own work and recover by restarting, canceling, or changing any item before taking a final enter action.

f. If data entries or changes will be nullified by an abort action, present the potentially nullified entries on the display and require the user/operator to confirm the abort.

g. Provide the capability to allow the user/operator to "take back" or undo the effects of at least the immediately preceding action.

h. Even if errors have been committed, do not permit escape from a partially completed transaction to result in incorrect or accidental modification of stored data or in initiation or modification of other system functions.

i. When the user/operator signals the end of a transactional session, check all pending transactions to determine whether the danger exists that data will be lost. If so, advise the user/operator of this likelihood before completing the logoff procedure.

j. Do not allow any error by the user/operator to terminate or abort the transactional session.

k. If the user/operator cannot meet the security requirements for part of the data, do not terminate or abort the transactional session.

l. If the user/operator cannot meet the security requirements for part of the data, do not impede access to that portion of the data for which the user/operator is cleared.

3.3.6 ADVISORY COMMENTS ON INTERRUPTS AND WORK RECOVERY

a. Alternative sensory channels

1. Use alternative sensory channels to warn the user/operator of incoming priority messages or tasks.

2. Use alternative sensory channels to warn the user/operator of partial equipment failures.

3. Use alternative sensory channels to maintain continuity of operations, even if in a degraded mode.

b. Multiple display devices

1. Display warning messages concerning impending interrupts in reserved areas on both displays.

2. Whenever possible, use the alternative display to deal with interrupt conditions. For example, if the user/operator is entering data on the alphanumeric screen when a high-priority message arrives, use the graphics screen to process the message, leaving the alphanumeric screen contents intact to facilitate resumption of the routine transaction.

c. Retain interrupt state

1. When routine operations must be interrupted because of higher priority work or partial functions, always save all data and commands related to current transactions.

2. After the cause of an interruption has been removed through processing or repair, advise the user/operator that normal operations can be resumed. Provide a single action (e.g., menu option, yes/no question, function key) to reload data and commands, restore displays, and continue routine operations from the point at which interrupted.

d. Automated file naming and storage

1. When periodic "saves" are made of data, active commands, and screen contents, also save the date and time, the user's/operator's logon information, the transaction type (e.g., data base update), and any other information that will help to identify the file.

2. Maintain a list of periodically-saved files currently available for user/operator review.

3. After the cause of an interruption has been removed, provide the user/operator with the option to resume the interrupted operation, or to defer that operation while doing something else. If the user/operator elects to defer the interrupted operation, hold the "interrupt file" until needed.

4. Provide a capability for a user/operator to review files on interrupted operations that are keyed to his/her logon ID.

5. Do not permit users/operators to review files on interrupted operations not keyed to their logon IDs unless they have specific authority to do so.

e. <u>Standard, editable startup configurations</u>

1. Provide software to save a table containing the current system configuration on peripheral storage as part of the shutdown procedure.

2. After power-up and automatic diagnostics, automatically load the system configuration that existed prior to the interruption of service. Display this configuration to the user/operator and provide the following options:

   (a) Accept the configuration as is.

   (b) Edit the displayed configuration.

   (c) Cancel the displayed configuration and construct an entirely new configuration.

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SECTION 4. MESSAGE COMPOSITION AIDS

Information in this category bears on methods for enhancing user/operator capabilities for generating messages and message elements. Two categories of messages are considered:

1. Alphanumeric messages, where information is of a textual or tabular nature.

2. Graphic displays, where information is of a pictorial, diagrammatic, or representational nature.

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4.1 Composition Aids for Alphanumeric Messages

4.1.1 DEFINITION

Alphanumeric messages are created out of standard alphabetic and numeric symbols. To the extent that standard grammatical symbols are required for textual presentation or for other types of separations, or that special symbols associated with a specific area of science or technology are required, alphanumeric messages also contain these additional symbols and symbol sets. Alphanumeric messages consist of: free text messages and reports; tabular presentation of data; and system HELP files and other types of system support aids. In addition, alphanumeric messages are almost always associated with graphic presentations. In this context, they are labels, other identifiers, and explanatory notations.

Alphanumeric message composition aids guide the user/operator to efficient construction of correct and complete alphanumeric messages and reports.

4.1.2 APPLICATIONS FOR COMPOSITION AIDS FOR ALPHANUMERIC MESSAGES

Composition aids for alphanumeric messages are appropriate for user/operator use in:

a. Generation of message elements which have a fixed format. NOTE: Full fixed alphanumeric message formats are system-provided and cannot be altered by the user/operator.

   EXAMPLE: In a field medical unit, a weekly medical supplies requisition is required. The list requires the following information: item name, item code, size, quantity, perishability status, date needed, substitution acceptable or not. The system provides no report format for the requisition. The user/operator generates a tabular "shell" with the appropriate column headings and stores it in the machine. Each week, now, the user/operator calls up the "shell" and completes the requisition.

b. Generation of variable format messages, or message elements which have a variable format.

   EXAMPLE: In a personnel system, data is usually received in a standard format on printed forms. However, several different forms are used and occasionally data are received in unstructured verbal reports. Forcing the user/operator to enter such data in a standard fixed sequence is an unnecessary burden since the system has the capacity to sort it out correctly once it is entered.

c. Generation of free text messages. NOTE: strictly speaking, the very act of creating a free text message makes it a variable format message or even a one-of-a-kind fixed format message. However, there are some aspects of generation of free text messages for which guidance is appropriate and is different from guidance provided for either fixed or variable type message construction.

   EXAMPLE: In a field artillery system, the tank commander files a situation report at the end of each training maneuver. Instructions for construction of this free text report advise that the order of importance in reporting is: successful aspects of the mission; unsuccessful aspects; identification of problems and deficiencies, especially as these relate to unsuccessful aspects; strategies for correction of problems and deficiencies; training implications; and methods for reinforcing successful training apsects. The commander creates a unique report based on actual conditions experienced.

4.1.3 BENEFITS OF COMPOSITION AIDS FOR ALPHANUMERIC MESSAGES

Use of composition aids in the construction of alphanumeric messages will enhance overall system performance through improved user/operator performance by:

a. Reducing error rates, by minimizing:

   1. The need to reformat standard messages or system inputs each time data are entered, thereby increasing the opportunity for typographical error.

   2. Imperfect recall of message or report requirements.

b. Increasing system throughput rates, by minimizing:

   1. Time to generate lengthy message formats for data entry.

   2. Time to correct errors in message format.

c. Reducing user/operator frustration:

   a. By minimizing the requirement to conform to message format and/or content requirements.

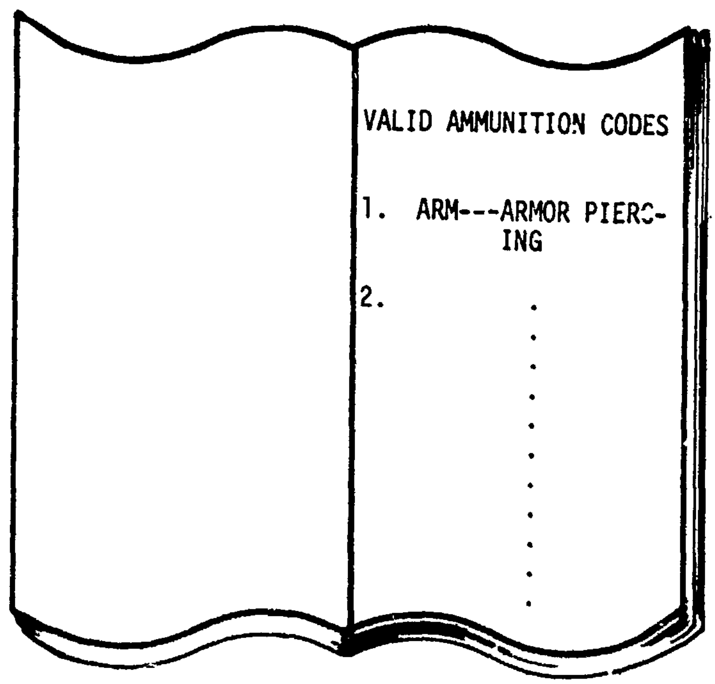
   b. By minimizing the need to refer to system documentation for determination of message format and/or content requirements.

4.1.4 METHODS FOR AIDING ALPHANUMERIC MESSAGE COMPOSITION

a. Form filling from legal entries. Construction of fixed message segment formats for use of legal entries is appropriate for situations where data entry requirements are rigid, i.e., where a list of legal entries is available either on-line or in a legal data entry code book or manual.

Data entry format: AMMO TYPE: _ _ _ ;

Legal entry list:



b. <u>Form filling from linked HELP files</u>. Construction which makes use of linked HELP files to structure fixed message segment formats is highly appropriate.

Data entry format: EQUIP:_ _ ;

First HELP file:

EQUIPMENT TYPE	LETTER CODE
COMBAT EQUIPMENT	CC
AIR EQUIPMENT	AI
TRANSPORTATION EQUIPMENT	TR
ENGINEERING EQUIPMENT	EN
etc.	

Data entry format: EQUIP: CC ; _ _ _ ;

Second HELP file:

COMBAT EQUIPMENT TYPE	LETTER CODE
ARMORED EQUIPMENT	ARM
COMMAND CONTROL EQUIPMENT	CMD
INFANTRY EQUIPMENT	INF
etc.	

Data entry format: EQUIP: CC ; ARM

c. Direct entry from system data. Construction of fixed message segment formats for direct entry from stored data is a viable method, but one for which there may be only limited opportunity available to the user/operator. One specific application of such a measure is the current time entry in a system with such a capability. Since the computer already "knows" to read current time from the system clock, the user/operator can designate a current time data entry field and the system will make a correct entry into this segment of the fixed format message.

d. Direct entry from user/operator-entered data. As with data entry from system data, limited application may also be found for direct entry of data from data previously entered by the user/operator. Computer-propagated data, i.e., replication of previously entered data, and computer-generated data, i.e., data calculated on the basis of previously entered data, can be automatically accessed and displayed.

e. Linked menus. Linked menus can be used to structure fixed format message segments in a fashion similar to that discussed for linked HELP files. The primary difference is that the menus are formatted in the form of questions.

```
IN WHAT TYPE OF EQUIPMENT ARE YOU INTERESTED?

    1. CO --- COMBAT EQUIPMENT
    2. AI --- AIR EQUIPMENT
    3. TR --- TRANSPORTATION EQUIPMENT
    4. EN --- ENGINEERING EQUIPMENT
    5. etc.

--> CO
```

```
IN WHAT TYPE OF COMBAT EQUIPMENT ARE YOU INTERESTED?

    1. ARM --- ARMORED EQUIPMENT
    2. CMD --- COMMAND AND CONTROL EQUIPMENT
    3. INF --- INFANTRY EQUIPMENT
    4. etc.

--> ARM
```

f. Cursor control dialog. Cursor control dialog is usually a special form of menu dialog in which the cursor, which may be moved with a variety of positioning devices, is placed next to or over the desired entry. Construction of fixed message segment formats is suitable for situations amenable to menu presentation and direct entry through, for example, a light gun, a joystick, a touch sensitive pad.

4.1.5 RECOMMENDATIONS FOR COMPOSITION AIDS FOR ALPHANUMERIC FORMATS

a. Table 4.1-1 presents recommendations for using particular methods for aiding the user/operator in composition of alphanumeric messages. Before deciding to use one or more of these methods, review the general recommendations that follow and consult the advisory comments on specific methods contained in Section 4.1.6.

Table 4.1-1. Methods for Aiding Alphanumeric Message Composition by Type of Format Application

KEY

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

		APPLICATION		
		FIXED ALPHANUMERIC FORMAT	VARIALBE ALPHANUMERIC FORMAT	FREE TEXT FORMAT
METHOD	FORM FILLING FROM LEGAL ENTRIES LIST	1	1	4
	FORM FILLING FROM LINKED HELP FILES	1*	1	4
	DIRECT ENTRY FROM SYSTEM DATA	1	2	3
	DIRECT ENTRY FROM USER/OPERATOR ENTERED DATA	2	2	1*
	LINKED MENUS	2	1*	1
	CURSOR CONTROL DIALOG	2	2	2

*Recommended as 1st choice for standardization purposes.

4.1.6 ADVISORY COMMENTS FOR AIDS FOR ALPHANUMERIC MESSAGE COMPOSITION

a. Form filling from legal entries

1. Form filling from legal entries is appropriate when the user/operator can transfer information (commands or data) to the screen from a hard-copy source. Make the sequence of entries consistent from hard copy to screen to reduce the requirement for cursor movement. It is also helpful if the screen display resembles the hard-copy format.

2. Avoid form filling from legal entries when requirements for completion of segments of the form are variable, i.e., conditional, optional, single and/or multiple entry allowed.

3. Avoid form filling from legal entries when the system would be required to shift from form to form. This slow type of data entry is particularly inappropriate when the system's data transmission rate is low.

4. Imbedded menus are simplified and relatively error-free methods for provision of form filling from legal entries. However, such formats use excessive storage space and may not be feasible under given system limitations.

b. Form filling from linked HELP files

1. Form filling from linked HELP files is particularly useful where low system storage capacity limits the amount of information which can be placed on data entry display menus--either straight menu presentation or format-imbedded menus--or in a series of HELP files.

2. Form filling from linked HELP files is especially appropriate when the information being handled is of a hierarchical nature.

3. Where the sophistication of users/operators is uneven and/or likely to improve over time, the availability of different levels of linked HELP files is important and can contribute to a significant savings of system time.

c. Direct entry from system data

1. Allow the user/operator control over the amount of information directly entered from system data. For example, the user/operator may wish to truncate a long listing of information or to delay its output until a later time.

2. Allow the user/operator to establish the presentation format for system-entered data. Under these circumstances, the user/operator could call out the format specifications and the system could automatically provide the correct data in the correct portion of the format.

3. Allow the user/operator to change a computer-generated value by providing a TAB BACK function key which moves the cursor back to the initial character of the data field.

4. When the computer automatically fills a data field, allow the cursor to automatically skip across the field to the next field in which the user/operator is to make an entry.

5. When the computer inserts data from a previous entry or calculates an entry from previously-entered data, display the data as a default value.

d. Direct entry from user/operator-entered data

1. Provide some simple construction/language usage HELPs to the user/operator.

(a) In report preparation, use active rather than passive construction.

EXAMPLE:

USE	DO NOT USE
The Commander stated that . . .	It was stated by the Commander that . . .

(b) Use short, simple, declarative statements, thereby clearly identifying the main topic.

(c) Use affirmative statements in reports; use negative statements to provide cautions against actions to be specifically avoided. When presenting cautions, maintain a consistent format and introduce the caution by a standard symbol.

(d) Use simple terms and use them consistently.

2. Use standard terms, codes, abbreviations that appear in doctrinal literature or that are familiar to the intended user/operator population in labeling data entry fields.

3. Use standard field delimiters for constructing alphanumeric messages and formats for alphanumeric messages.

4. When the computer inserts data from a previous entry or calculates an entry from previously entered data, display the data as a default value.

e. Linked menus

1. Use linked menus when a hierarchical menu structure is appropriate, i.e., when sequentially more and more refined selection is to be made.

2. Use menu dialogs where menus of different levels of detail are appropriate due to differences in sophistication in system operation on the part of the user/operator.

3. Provide a method for user/operator by-pass of linked menus by stacking commands, especially when the system's data transmission rate is slow and when variable levels of user/operator skill in system operation can be expected.

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4.2 Composition Aids for Graphics Displays

4.2.1 DEFINITION

Graphics displays are screen and hardcopy diagrammatic and pictorial presentations. To a greater extent than for alphanumeric messages and message segments, the content and structure of graphics displays are at the discretion of the user/operator. Thus, advising the user/operator on graphics display construction has great importance.

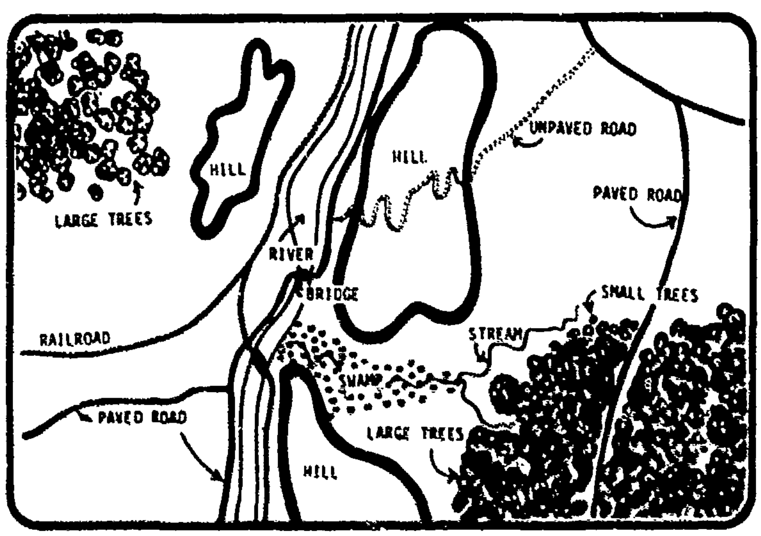
Construction of graphics displays can become very complicated; a system with graphics capability can add a great number of dimensions and a great amount of versatility to system output. Without proper utilization of this graphics capability, however, inferior output will occur. Yet, it is not the function of this information to provide a course of instruction or even a "tutorial" to the user/operator in composition of graphics displays. Thus, there must be transparent features of the system which lead the user/operator to construction of "good" rather than "bad" graphics displays.

4.2.2 APPLICATIONS FOR COMPOSITION AIDS FOR GRAPHICS DISPLAYS

Composition aids for graphics displays are appropriate for user/operator use in:

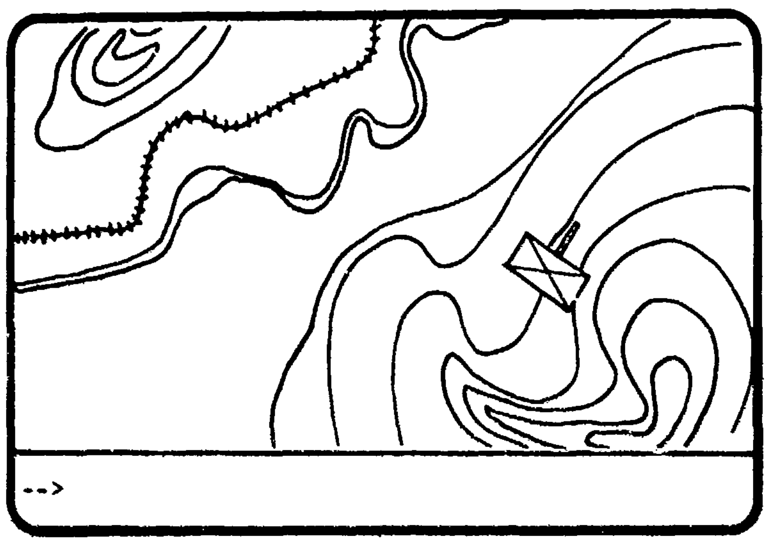
a. Creation of maps and charts.

EXAMPLE: The tank battalion commander requests that one of the forward tanks provide a description of the terrain immediately ahead. The user/operator in the lead tank creates a rough map of the area by sketching with a light pen and calling up standard mapping symbols already stored in the machine and placing them at appropriate locations on the map. Alphanumeric identifiers are also added to call out important terrain features. The display is then transmitted to the tank battalion commander.



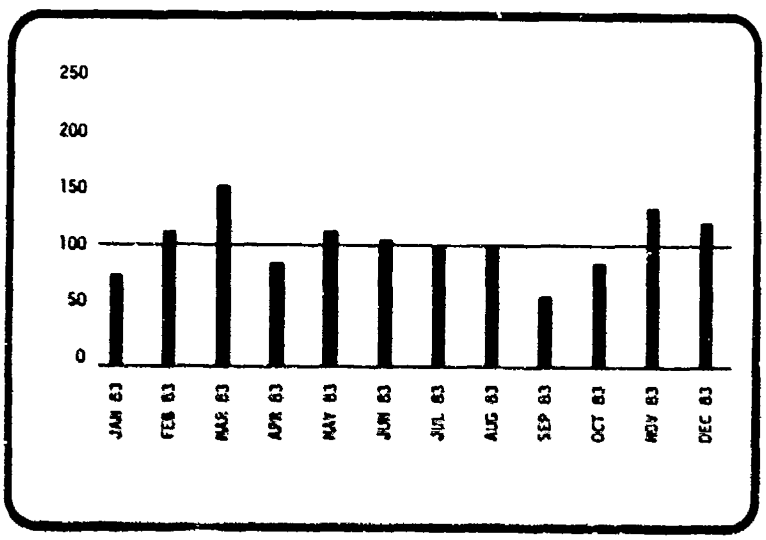
b. <u>Creation of overlays for maps, charts, and other pictorials.</u>

EXAMPLE: Through the combination of a map display and map overlay capability, an artillery unit has the capacity to graphically portray not just unit location but firing orientation as well. The user/operator enters the map grid in the map display. By calling up the unit and equipment symbols, entering the alphanumeric coordinates information for positioning the symbol(s), and the numeric orientation value for the desired firing direction, the unit's location and firing orientation are stored in the machine and displayed on the map via the map overlay.



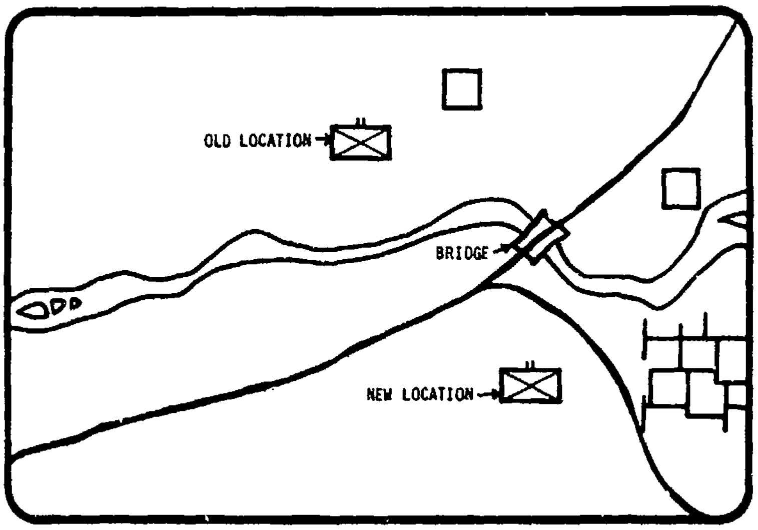
c. <u>Creation of bar charts, histograms, etc., for representation of quantitative information.</u>

EXAMPLE: For a logistics function, the user/operator wants to make a graphics display of comparision of available and authorized stock levels of a particular piece of equipment over a twelve month period. The data are stored in the computer by equipment type and retained online for a three year period. The user/operator specifies the following to the computer as data to be dealt with: equipment code; time frame; authorized level, to be displayed as 100 percent on a month by month basis; and peak availability during the month, to be displayed as a percentage of the authorized level on a month by month basis. The instruction to the computer includes construction of a line chart for authorized level (a straight line at the 100 percent level) and a vertical bar chart to show "peak monthly availability."



d. Creation of free form drawings.

EXAMPLE: An artillery unit wants to move its fire units to the other side of a stream which is too deep to ford. The Corps of Engineers is designated to build a pontoon bridge to facilitate the crossing. As part of the request and specifications for the bridge, the artillery commander draws a rough map and transmits it to the engineering unit.



4.2.3 BENEFITS OF COMPOSITION AIDS FOR GRAPHICS DISPLAYS

Use of composition aids in the construction of graphics displays will enhance overall system performance through improved user/operator performance by:

a. Reducing error rates, by minimizing:

   1. Inaccuracy or poor judgment in placing symbols and lines within the display.

   2. Errors in specification of correct, standard, and/or doctrinal symbology.

   3. Imprecise retrieval of data to be displayed through incomplete or inaccurate specification.

b. Increasing system throughput rates, by minimizing:

   1. Time required to position desired symbols within the graphics display.

   2. Time required for direct keyboard entry of position and symbols identification information.

   3. Time required to correct errors in graphics data specification and positioning.

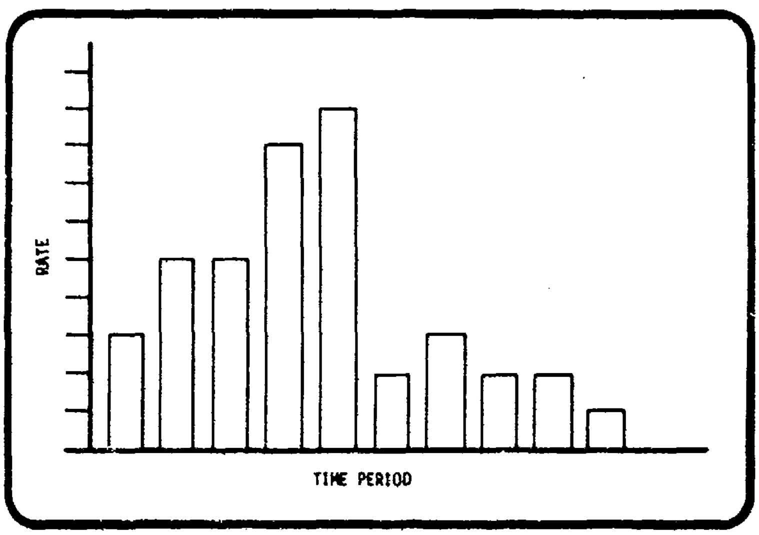
c. Message integrity, as enhanced by:

   a. Reduced misestimation of positioning of symbols or points on graphics displays.

   b. Conformity to standards thereby reducing potential for misinterpretation of the graphics display.

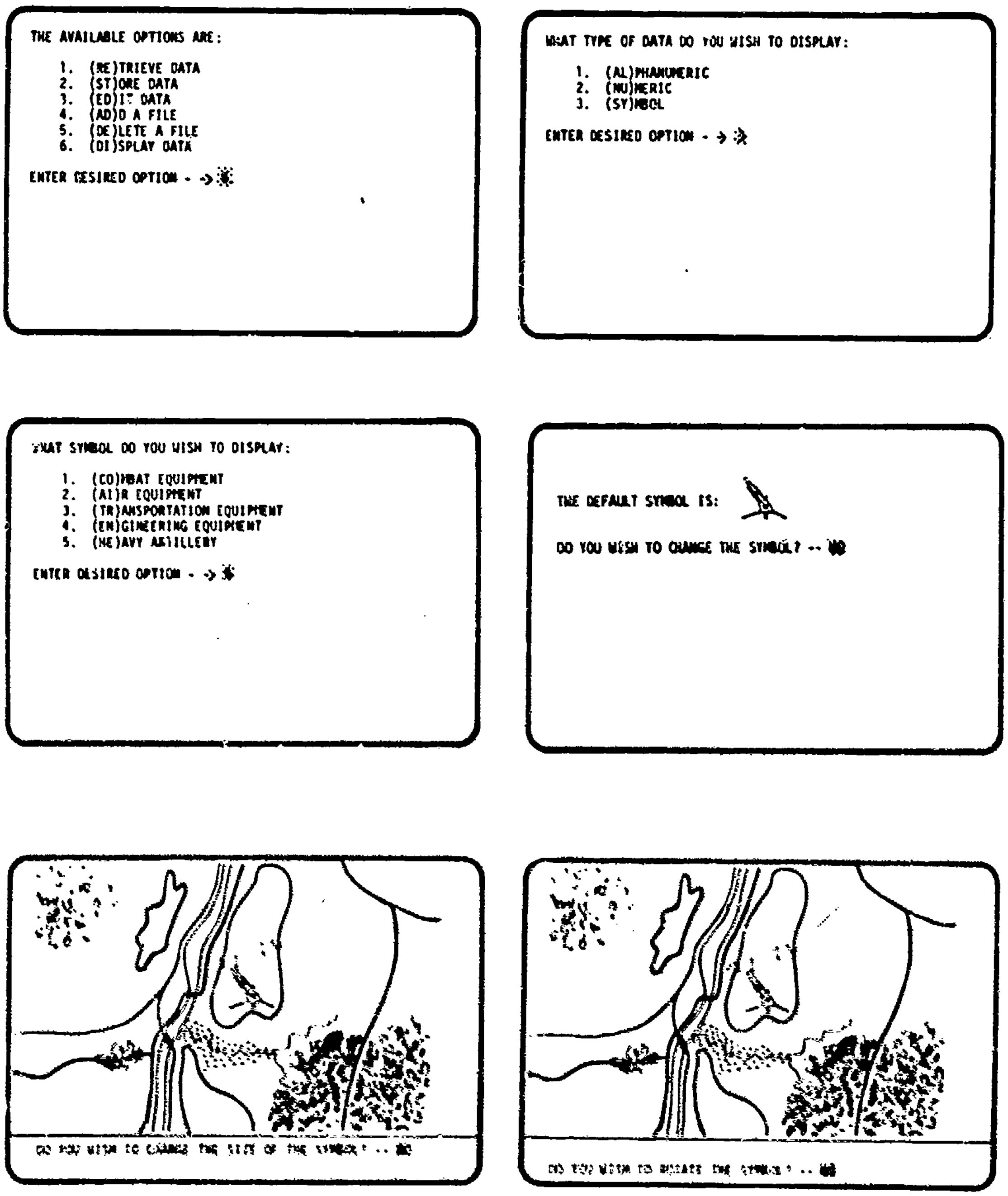
4.2.4 METHODS FOR AIDING GRAPHICS DISPLAYS COMPOSITION

a. Direct entry from system data. Construction of graphics displays from system-stored data is particularly appropriate for presentation of quantitative data. Data retrieval and layout specifications are necessary. The availability of stored graphics elements, e.g., pictorial symbols, color associations, which are in conformance to standards, enhances the production, authenticity, and accuracy of graphics displays.



b. User/operator-entered data. Construction of graphics displays from user/operator-entered data has the greatest potential for versatility of graphics displays. Unless the system restrains the user/operator from generation of inappropriate graphics displays, however, hard-to-interpret "bad" displays may result. The system should protect the user/operator from generating displays which, for example, permit inadvertent destruction of display features by unintentional overprint, bleeding of colors due to excessive color saturation, or masking of successive lines due to placement of lines which exceeds resolution capability.

c. <u>Linked menus</u>. Linked menus, either of straight alphanumeric construction, or preferably of a combination of alphanumeric and graphics structure, can be used to aid in the composition of graphics displays.



d. Digitization. Digitization is an efficient method for graphics interaction since it depends to a large extent on the features and capabilities of the digitizing device. A great variety of digitizing devices is available, as discussed in Section 1.2.4, Methods for Graphics Control. Composition aids for digitization are linked to the features of the device and to the specifications for data output--usually a form of imagery or map displays.

e. Joystick, light pen, trackball, etc. These devices are essentially methods for placing a cursor on a screen for selection or entry of an item of information. Characteristics of a variety of joystick types, etc., are discussed in Section 1.2.4, Methods for Graphics Control. Composition aids for these interactions are linked to the peculiar features of the equipment and to the specifications for the graphics display output.

f. Touch sensitive surface. Creating displays through use of a touch sensitive surface is essentially a cursor application which makes use of the heat registered on the surface when a finger is pressed against it. Graphics display composition by this method is subject to the capabilities and sensitivities of the equipment and to its compatability with the requirements imposed on the graphics display output.

4.2.5 RECOMMENDATIONS FOR COMPOSITION AIDS FOR GRAPHICS DISPLAYS

a. Table 4.2-1 presents recommendations for using particular methods for aiding the user/operator in composition of graphics displays. Before deciding to use one or more of these methods, review the general recommendations that follow and consult the advisory comments on specific methods contained in Section 4.2.6.

Table 4.2-1. Methods for Aiding Graphics Display Composition by Type of Format Application

KEY:

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

	APPLICATION				
METHOD	MAPS AND CHARTS	MAP OVERLAYS	BAR CHARTS, HISTOGRAMS, ETC.	FREE FORM DRAWINGS, SKETCHES	IMAGERY
DIRECT ENTRY FROM SYSTEM DATA	2	1*	1*	2	1
USER/OPERATOR ENTERED DATA	1*	1	1	2	2
LINKED MENUS	3	2	2	4	4
DIGITIZATION	1	2	2	4	1*
JOYSTICK, LIGHT PEN, TRACKBALL, ETC.	2	2	2	1*	2
TOUCH SENSITIVE SURFACE	2	2	2	1	4

*Recommended as 1st choice for standardization purposes.

4.2.6 ADVISORY COMMENTS FOR METHODS FOR AIDING GRAPHICS DISPLAYS COMPOSITION

a. Direct entry from system data

1. Allow the user/operator control over the amount of information directly entered from system data. For example, the user/operator may wish to restrict presentation of trend data by time interval, or curtail the number of variables presented on the chart.

2. Allow the user/operator to establish the presentation format. Under these circumstances the user/operator, for example, would specify the length of the "x" and "y" axes of a chart, as well as the intervals along each dimension. These features could be established most easily through menus or question and answer dialog techniques.

3. Allow the user/operator to change a computer-generated display. For example, the user/operator may want to extend a trend analysis on the basis of the displayed parameters, or may want to project a trend on the basis of modified parameters.

4. Provide a standard set of symbols for user/operator selection appropriate to the task. Allow the user/operator placement of selected symbols and alteration of symbol size and color, if a color capability is provided.

b. User/operator-entered data

1. Allow the user/operator direct entry of data for incorporation into graphics displays generated as direct entry from system data.

2. Give the user/operator access to standard display formats for generation of graphics such as bar charts, pie charts, frequency polygons. Under these circumstances, the identification of display parameters, e.g., intervals, headings, colors, is at the discretion of the user/operator.

3. Make standard graphics symbology available to the user/operator for incorporation into graphics displays. Question and answer and menu dialog techniques can readily support this function. If color graphics are possible, color can be added to the graphics by the same dialog technique(s).

4. Allow the user/operator to employ the alphanumeric features of the system to provide headings and annotations rather than providing alphanumerics as a product of the graphics capabilities (i.e., by "keying in" rather than "sketching" letters, numbers, and standard grammatical symbols).

c. Linked menus

1. Provide a series of linked menus through which the user/operator can generate standard graphics displays such as bar charts, frequency polygons, pie charts. The linked menu approach allows the user/operator to step through, for example, selection of display format; identification of data categories; dimensions of data categories; symbols and their placement.

2. Allow the user/operator to add headings and annotations to graphics displays through the use of linked menus. According to what capabilities the system possesses, such menus step the user/operator through, for example, heading and annotation style (upper/lower case, type font, type size); location; color; and color intensity.

d. Digitization

1. Make the user/operator aware of the accuracy requirements of the particular assignment being accomplished. That is, some applications may require very precise results (maps drawn for targetting purposes), some may require only minimal precision (rough sketches of two areas under preliminary consideration for training maneuvers). The user/operator can exercise control of accuracy through speed with which digitization is performed.

2. Make the user/operator aware of graphics conventions required for correct interpretation of products of digitization. These conventions can be provided through a menu or question and answer structure for each relevant application as, for example, those appropriate to showing topographic versus cultural characteristics of a given area on a map.

e. Joystick, light pen, trackball

1. These features are conducive to generation of simple graphics such as line drawings, bar charts, frequency polygons and, in fact, provide a very versatile system. The speed at which the joystick, etc., moves contributes to the accuracy of the graphics display being created. Allow the user/operator to adjust or control cursor movement/speed in accordance with graphics display accuracy requirements.

2. Allow the user/operator to vary the width of the line (image) created by manipulation of the joystick, light pen, trackball, etc. These devices do not independently have the capability to provide line width variation. Variation in line width can be provided by "tieing in" a different alphanumeric key to the joystick capability. A set of three keys would permit three width variations, four keys would permit four variations.

f. <u>Touch sensitive surfaces</u>

1. Touch sensitive pads and surfaces restrict the user/operator to placement of display parameters one at a time. They are appropriate for quick location of a specific symbol on a variable graphics display, e.g., a map or map overlay, and are particularly useful for demonstrating and communicating direction of movement.

2. Allow the user/operator to select between "dynamic" and "static" operation of the touch sensitive surface. In the "dynamic" mode, the cursor continues to move across the surface in the indicated direction at some set pace once the user/operator has set the cursor in action. In the "static" mode, the cursor moves only at the command of the user/operator, i.e., as the user/operator touches and retouches the touch sensitive surface.

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SECTION 5. DATA RETRIEVAL ASSISTANCE

Guidelines in this category present the capabilities required to support user/operator interaction with system data bases. Two aspects of data retrieval assistance, user/operator query methods and query structure, are examined.

1. Query Method. Query methods are the ways in which users/operators may identify the characteristics of the data base contents which they wish to review or alter.

2. Query Structure. Query structure relates to ways in which interaction with system data bases may be organized, structured, and sequenced.

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5.1 Query Methods

5.1.1. DEFINITION

Query methods are techniques by which the user/operator may access the data base and identify the data required for task processing by the system and/or the user/operator.

5.1.2. APPLICATIONS FOR QUERY METHODS

Tasks or procedures for which query methods are applicable include those tasks which require the user/operator to interact with stored data or data base information.

a. The user/operator will have occasion to check portions of the data base to verify presence and accuracy of data.

EXAMPLE: A user/operator may be required to confirm a last known position of an identifiable troop concentration. If this information is in the data base, entry of the troop ID code should display troop data including last known position.

b. The user/operator will be required to retrieve information from the data base for the purpose of examination and evaluation.

EXAMPLE: The user/operator may be required to assign 50 rounds of phosphorous to a known target from a single battery. The data base should confirm ammunition information through a query with the battery's ID.

c. The user/operator will frequently retrieve information from the data base for deletion, modification, processing, or addition.

EXAMPLE: The user/operator may be required to update certain perishable data in the data base. Update will likely require all of the following steps: identifying the data, querying the data base, retrieving the data, examining the data, entering the proper code(s) to gain access for deletion or modification, and deleting or modifying the data.

5.1.3 BENEFITS OF QUERY METHODS

The benefits derived from the use of user/operator responsive query methods include:

a. Reduced error rates, by minimizing:

1. Difficulty in manipulating data in and out of the data base.

2. Skill level demands on user/operator memory or concentration.

b. Increased system throughput rates, by minimizing:

1. Time for access to information required for and vital to mission effectiveness.

2. Extended time for use by the user/operator under varied or undesirable operating conditions.

c. Increased system security, by including:

1. Methods for prevention of unauthorized access to information resident in the data base.

2. Methods for prevention of unathorized or accidental change/ deletion of data base information.

d. Decreased training time/complexity, by addressing:

1. Methods adaptable to different types of command dialogs. Retraining may not be required on new command languages, for example.

2. Ease in manipulating data into or out of the data base.

5.1.4 METHODS FOR IMPLEMENTING QUERIES

a. User-initiated query language dialog, in which the user/operator enters queries in response to a prompt symbol appearing on the terminal. The prompt is typically brief, so the user/operator must remember the query codes and options and accurately type them at the terminal.

EXAMPLE: The user/operator wants to retrieve the full file content of today's transactions between the hours of 0945 and 1315. The user/operator enters "QUERY:" to specify dialog type. When it is possible for the user/operator to obtain the file content by entering the code for file type "HI" (for historical file) and the time interval code "0945-1315."

```
QUERY: FILE HI 0945-1315
```

b. Natural language dialog, which is typically user-initiated query language, in which the designer attempts to make the query language as much like standard English as possible.

EXAMPLE: For the same request as described above for user-initiated dialog, the natural language dialog sequence appears on the screen as follows.

```
QUERY: RETRIEVE THE HISTORICAL FILE CONTENTS FROM
       0945H TO 1315H.
```

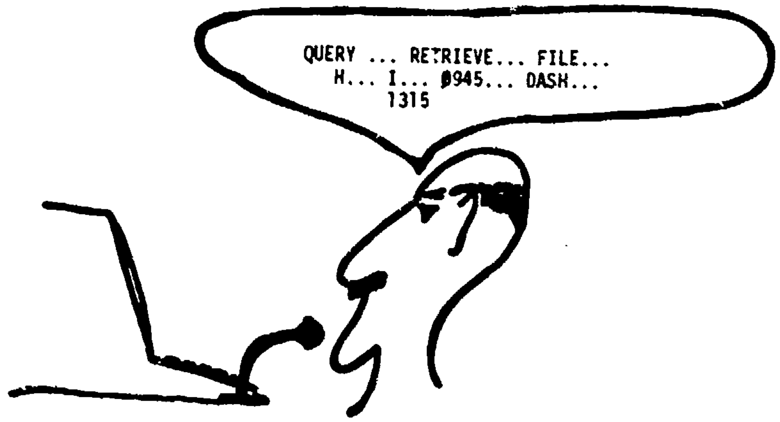
c. <u>Menu selection</u>, in which the user/operator selects a desired command from a list of commands presented on the display. The user/operator then enters the code, word, or number associated with that command.

```
THE AVAILABLE RETRIEVE OPTIONS ARE:

    1.  (AC)TIVE DATA FILE
    2.  (HI)STORICAL DATA FILE
    3.  (FR)IENDLY ARMOR LOCATIONS
    4.  (UN)FRIENDLY ARMOR LOCATIONS
    5.  (ST)ANDARD REPORT FORMAT





ENTER DESIRED OPTION-->
```

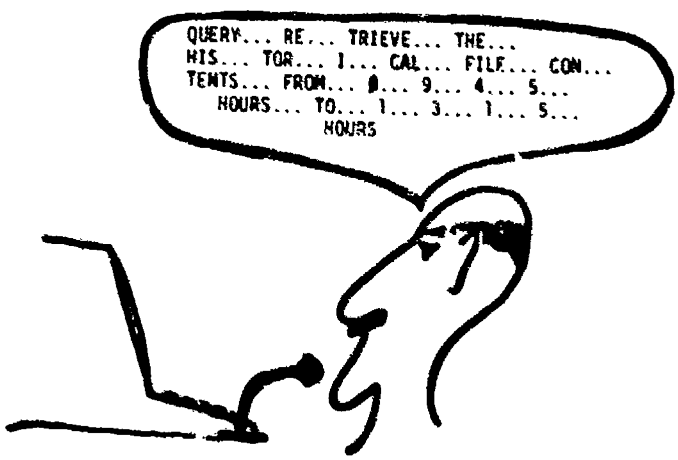
d. <u>Fill-in-the-blanks</u>, in which the user/operator fills out a form or questionnaire presented at the terminal. The entries in the "blanks" may be words, codes, numbers, or merely symbols ("checkmarks" or "Xs") to indicate that the user/operator wishes to perform the operation displayed on the "form."

```
USER CODE NUMBER:______-___-___ID NUMBER:_____-__

ACTIVITY OPTIONS:__RETRIEVE__ EDIT

DATA OPTIONS:

    __ACTIVE DATA FILE
    __HISTORICAL DATA FILE
    __FRIENDLY ARMOR LOCATIONS
    __UNFRIENDLY ARMOR LOCATIONS
    __STANDARD REPORT FORMAT





HARD COPY DESIRED? (Y/N)__
```

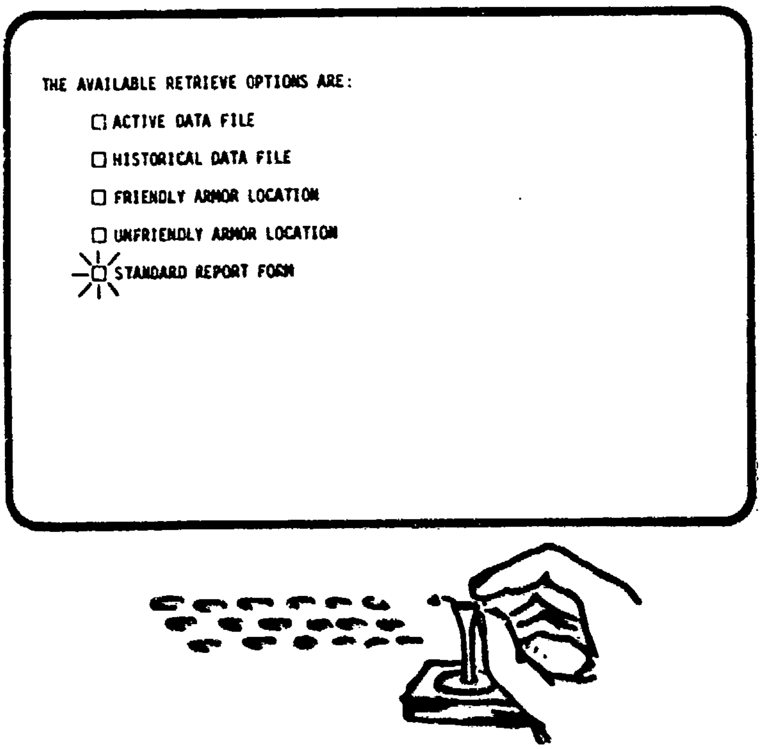
e. Voice input query language, in which the user/operator enters the syntax and structure of the query language through the spoken voice, rather than keyboard or cursor.



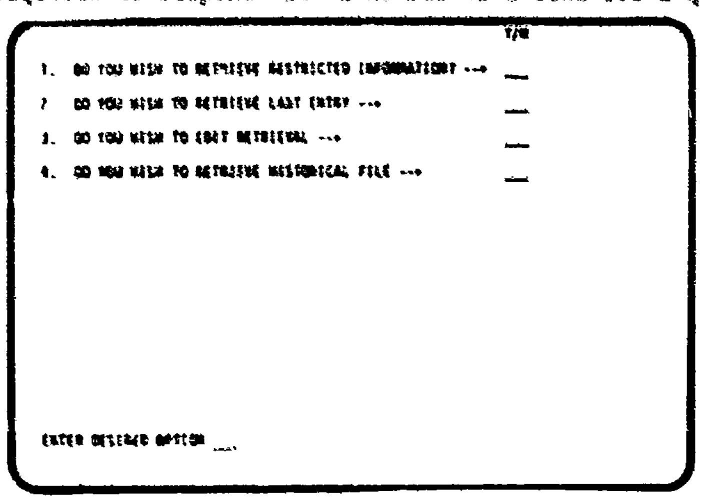
f. Voice input natural language, which is typically a form of user-initiated query language, where the user/operator speaks commands instead of typing them.



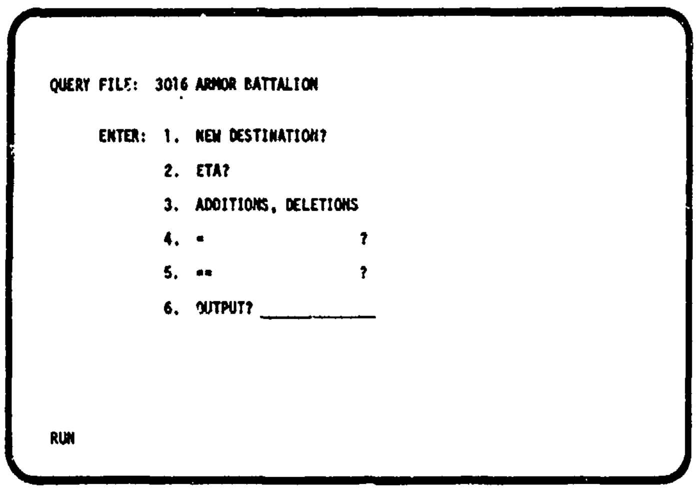
g. Cursor control dialog, which is usually a special form of menu dialog, in which the user/operator positions the screen cursor next to the desired command. The cursor may be moved with any graphic positioning device. In the example below, the user/operator is using a joystick.



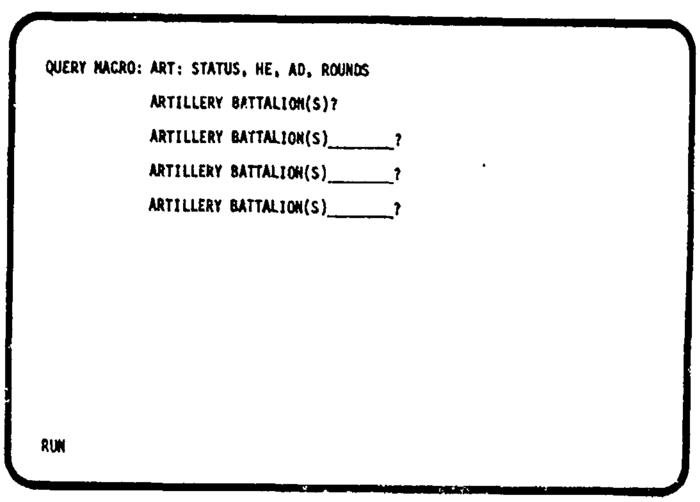
h. Question and answer dialog, in which the computer system asks the user/operator specific questions. In the simplest form of this type of dialog, the user/operator may respond only with "Y(ES)" or "N(O)." In more complex forms, the user/operator may be required to respond with a number or a code for a query.



i. Query command file, which is typically user-built and initiated. The user/operator supplies some prompted information and then runs the file.



j. Query command macro, which is an enhanced form of command file in which the user/operator may conveniently alter variable elements in the command file.



5.1.5 RECOMMENDATIONS FOR QUERY METHODS

Selection of the query method depends on the nature of the system being developed and the characteristics of the expected users/operators of the system. Some of the most important factors in making this decision are:

a. Sophistication of the users/operators:

1. HIGH level of sophistication means that users/operators are very familiar with the system, its capabilities, and the sequences of operations which the system will perform. Users/operators with a HIGH level of sophistication will have either (a) received a substantial amount of training in system operation or (b) had considerable experience in operating the system by the time they are called on to use it in operational situations, or (c) both of the above.

2. MEDIUM level of sophistication means that users/ operators are quite familiar with the most important capabilities and commands of the system, but are not intimately familiar with little-used system features. Users/operators with a MEDIUM level of sophistication may have received considerable training, but will not use the system enough to maintain their knowledge about all of the system's capabilities.

3. LOW level of sophistication means that users/operators are familiar only with the "big picture" of system operation. They may be unfamiliar with the range of capabilities of the system.

4. VARIABLE level of sophistication means that different users/operators have different levels of sophistication in using the system. Some may be very familiar with its features and capabilities, while others will be aware of only the most elementary and important features.

b. Requirements of data retrieval type:

1. ROUTINE--output format and data fields are substantially constant either between reports or for single reports produced frequently.

2. NONROUTINE--output format and data fields are unpredictable and vary over a wide range for single reports and across reports.

3. VARIABLE--output format and data fields are constant for a section of outputs, but not predictable for individual reports or sections.

c. Daily usage--number of times typical query will be used by a typical user/operator in a given period of time.

   1. HIGH--typical query used 5 times per day or more.

   2. MEDIUM--typical query used twice per week or more but less than 5 times per day.

   3. LOW--typical query used less than twice per week.

d. Computer-to-terminal data transmission rate.

   1. HIGH--4800 baud (480 characters per second) or greater.

   2. MEDIUM--1200 baud (120 characters per second) or greater, but less than 4800 baud (480 characters per second).

   3. LOW--less than 1200 baud (120 characters per second).

e. Number of queries in usage.

   1. HIGH--46 or more queries available for use with the system.

   2. MEDIUM--16 to 45 queries available.

   3. LOW--15 or less queries available.

f. Table 5.1-1, Query Method by System and System User Characteristics, presents a <u>general</u> list of recommendations for selecting query types. Before making a final decision, consult the specific recommendations for individual query types in Section 5.1.6.

   To use the table, first decide what system and system user characteristics apply to the situation you are considering. Eliminate any query types where a "4" appears as an entry. Select the best query type by comparing the remaining types in view of the characteristics of the system you are conceptualizing of designing.

Table 5.1-1. Query Method by System and System User Characteristics.

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

	CHARACTERISTICS OF SYSTEM OR SYSTEM USER															
	SOPHISTICATION OF USERS				REQUIREMENTS OF DATA RETRIEVAL TYPE			DAILY USAGE OF TYPICAL QUERY			COMPUTER TO TERMINAL TRANSMISSION RATE			NUMBER OF QUERIES IN USAGE		
METHOD	HIGH	MED	LOW	VAR	ROUTINE	NON-ROUTINE	VAR	HIGH	MED	LOW	HIGH	MEDIUM	LOW	HIGH	MED	LOW
QUERY LANGUAGE	1*	1	3	3	1*	1*	1*	1*	2	3	1*	2	3	1*	1	1
NATURAL LANGUAGE	3	3	3	3	1	2	2	3	3	2	2	2	2	2	2	3
MENUS	3	1*	1*	1*	1	1	1	1	2	2	1	2	4	2	2	1
FILL-IN-THE-BLANKS	2	2	3	3	2	1	3	4	3	3	2	2	4	4	3	3
VOICE INPUT QUERY LANGUAGE	2	2	2	2	2	2	2	1	2	3	1	2	3	4	3	3
VOICE INPUT NATURAL LANGUAGE	3	3	3	3	2	3	3	3	3	2	2	2	2	4	3	3
CURSOR CONTROL DIALOG	2	2	1	2	1	1	1	3	3	3	3	3	3	1	1	1
QUESTION & ANSWER DIALOG	2	2	2	3	2	3	3	4	5	2	2	2	4	4	3	3
QUERY COMMAND FILE	1	2	3	3	2	2	2	1	2	2	2	2	2	1	2	3
QUERY COMMAND MACRO	1	2	3	3	2	2	2	1	2	2	2	2	2	1	2	3

* Recommended as 1st choice for standardization purposes.

g. Do not permit deletion/alteration of data items by direct command entries without first displaying the value to be deleted/altered.

h. Permit the user to request "HELP" as necessary to determine required parameters in a command entry, or to determine available options for an appropriate next command entry.

i. When user/operator computer dialog involves prompting, prompt data entries explicitly, by displaying data field labels and/ or associated user/operator guidance messages.

j. When useful default values cannot be predicted in advance, provide a capability for authorized personnel to use a special transaction to define, change or delete default values for each data field.

k. Provide the capability for the user/operator to change a computer-generated data value. However, before permitting the value actually to be changed, display the basis for the computer calculations.

1. Do not force the user/operator to press more than one fixed function key (e.g., SHIFT or ENABLE plus the function key) to perform a simple operation.

   EXCEPTION: If unintentional activation of a fixed function key would have serious consequences for system operations or system output, <u>do</u> require the user/operator to press two keys simultaneously to activate that function.

5.1.6 ADVISORY COMMENTS FOR QUERY METHODS

a. User-initiated query language dialog

1. Make terms, codes, etc. in query languages consistent with those used in the overall control method for the system.

b. Natural language dialog

1. Where some sophisticated users will use a system with natural language dialog, provide for command codes and abbreviations as an option to natural language interaction.

c. Menu selection

1. Word menu options so as to permit direct selection of any option as an acceptable contol input, either by pointing or by code entry. Do not word menu options so as to imply a question requiring a YES/NO answer.

2. If menu selection is used in conjunction with or as an alternative to query language, then display selected query options until the user signals entry of a completely composed command.

3. Display menu options in a logical order; if no logical structure exists, then display options in order of their expected frequency of use, with the most frequent listed first.

4. In a displayed menu, include only those options appropriate at that particular step in a transaction sequence, and for the particular user.

5. If possible, in a displayed menu include all query options appropriate at that particular step in a transaction sequence.

   EXCEPTION: A familiar set of general control options always available may be omitted from individual displays; it should be available on demand, however.

6. When option selections must be made from a long list, and not all options can be displayed at once, provide a hierarchic sequence of menu selections rather than one long multi-page menu.

   EXCEPTION: Where a long list is already structured for other purposes, such as a list of customers, a parts inventory, a file directory, etc., it might be reasonable to require the user to scan multiple display pages to find a particular item. Even in such cases, however, an imposed structure for sequential access may prove more efficient.

COMMENT: Multi-page option lists will generally hinder learning and use. The software designer can usually devise some means of logical segmentation to permit several sequential selections among few alternatives instead of a single difficult selection among many.

7. When the user must step through a sequence of menus to make a selection, design the hierarchic structure, insofar as possible within the constraints of display space, to minimize the number of steps required.

8. When hierarchical menus are provided, design them to permit the user immediate access to critical or frequently selected options.

9. If letter codes are used to make menu selections, then insofar as possible, use those codes consistently in designating options at different steps in a transaction sequence.

   EXAMPLE: Do not give the same action different names and hence different codes (F=FORWARD and N=NEXT); do not give the same code to different actions (Q=QUIT and Q=QUEUE).

10. Always make an initial menu of control options available for user selection, to serve as a "home base" or consistent starting point for control inputs at the beginning of a transaction sequence.

    COMMENT: Such a starting point is helpful even when all dialog is user-initiated. This capability can be implemented as an OPTIONS function key, as an explicit control option on every display, as a generally available implicit option, or as a consistent default for a null control input.

11. Use menu selection for routine tasks with fixed procedures requiring only minimal entry of arbitrary data.

12. Do not use menu selection dialog when the transmission rate will be less tha 1200 baud. Relatively fast computer response time is required for menu selection dialogs because the menu options must be transmitted and displayed for each selection.

13. When menu selection is used to train novices to use a command language, make the wording and order consistent with the command language.

14. If the selection list exceeds 10-15 items, reorganize the list into two separate menu frames, maintaining the logical organization within the hierarchy.

15. If selection items have been grouped, label each group.

16. When hierarchic menus are provided, give the user some displayed indication of current position in the menus structure.

17. Present menus successively in the same area of the display rather than simultaneously in different areas.

18. If the user population is variable, provide various menus with different levels of detail.

19. Provide multiple paths to accommodate both experienced and inexperienced users. For example, allow experienced users to bypass the menu hierarchy and directly acess a given menu by entering its page number or identification code.

20. Sequence menu frames in an order dictated by the logical flow of the user's analysis of the transaction.

21. Allow menu selections by the user to be accepted in either abbreviated or complete form.

22. Permit users to enter a series of menu selections (command stack) to speed the dialog and avoid the need to display each menu. When an error occurs in a menu command stack, program the computer to proceed as far as possible and then give a message indicating where it stopped processing and which query elements could not be processed.

23. Command stacking is essential when system response time is such that over 2 seconds is required to display a menu.

d. Fill-in-the-blanks

1. When using form filling, provide a convenient means to control cursor movement from field-to-field as well as from line-to-line and character position-to-character position.

2. When the user/operator is entering query elements from a hard copy form, make the image of the form displayed on the CRT screen look as much like the hard copy form as possible.

3. Provide a "reverse tab" feature to allow users to correct information in fields which they have already completed.

e. Voice input query language

1. Use voice input when the user's eyes and hands will be typically involved with other system tasks.

2. Use voice input when ambient noise levels are below 90 dba.

f. Voice input natural language

1. Use voice input where the user's/operatór's hands and eyes are already being used extensively in other system operations.

2. Limit the use of voice input to situations where the ambient noise level is less than 90 dba.

g. Cursor control dialog

1. When selection among displayed query options is to be accomplished, place the cursor automatically on the most likely options at initial display generation.

2. Accomplish designation on an electronic display by means of a movable cursor with distinctive visual features (shape, blink, etc.).

3. Design the cursor so that it does not obscure any other character displayed in the position designated by the cursor.

4. Where the "targets" for the cursor are arranged in rows or colulms, design the cursor interaction such that the cursor can move only along the row or column in which the "targets" appear. That is, do not allow the cursor to move into horizontal areas where no target apears.

5. When position designation is combined with keyed data entry, control cursor movement at the keyboard (by function keys, joystick, etc.), rather than by a separately manipulated device (light pen, "mouse," etc.).

6. Automatically skip the cursor past any data field filled by computer-generated data.

7. Use cursor control dialog when conceptualizing or designing systems which have interactive graphics as their primary purpose, but which must also use alphanumeric menu presentation in some processing steps.

8. Avoid using cursor control dialog when the users/operatórs of the system will have no need to control the position of the cursor on the CRT screen other than to select items from an alphanumeric command menu or list.

9. Use the same method for cursor control dialog as is used for graphics interaction.

10. When using cursor control dialog, make the "target" for the cursor at least 10 times the size of the positioning accuracy required for interactive graphics or 1/4" square, whichever is smaller.

11. Provide feedback to the user/operator on which "target" has been selected by cursor control dialog. Making the selected target brighter is the preferred method.

h. Question and answer dialog

1. Use question and answer dialog for routine query tasks, where data items are known and their ordering can be prespecified, where the user will have little or no training, and where computer response is expected to be moderately fast.

2. Brief question and answer sequences can be used to supplement other dialog types for special purposes, such as for log on routines, or for resolving ambiguous control inputs or data entries.

3. Use question and answer dialogs only when the users/operators are likely to be very unsophisticated in using system capabilities.

4. Use question and answer dialogs when the users/operators are required to provide only "YES" or "NO" answers to questions about desired query results.

5. Use question and answer dialogs when the user/operator is required to enter information which cannot be placed on a list or easily encoded (e.g., time other than current time; number of troops).

6. When using question and answer dialogs, provide examples of required query format and content whenever possible.

i. Query command file

1. Use query command files where complex data retrieval and manipulation constitute the majority of the operator's workload.

2. Use query command files where retrieval can be complex but results in substantially the same format.

j. Query command macro

1. Use query command macros when data retrievals and manipulations are complex but have many stable parameters.

2. Use query command macros when separate data retrievals and manipulations involve the same data and similar processing.

3. Use query command macros when separate data retrievals and manipulations involve the same processing with different data.

4. Allow the user/operator to construct query command macros which can query the user/operator for parameters whose values change over time.

5. Display the current value of any control parameter(s) currently operative for user reference.

   COMMENT: This practice is helpful even when all parameters are user-selected since the user may well forget them, particularly if task activities are interrupted.

5.2 Query Structure

5.2.1 DEFINITION

Query structure refers to the ways in which the user may organize requests for information. It deals with issues such as: the legal sequences of query elements; the use of delimiters between elements; and the ways in which the user may indicate/select options in query specification.

5.2.2 APPLICATIONS FOR QUERY STRUCTURE

Query structure is applicable wherever the user/operator must interact with stored or data base information to retrieve data. Query structure influences the query method to be employed and, thus, is applicable in the user's/operator's choice of technique in accessing the system. Query structure can be delineated by four different degrees of complexity: Simple, Moderate, Complex, and Extreme.

a. A SIMPLE query structure represents the least complex data retrieval type. It contains a single data item or single parameter. This structure is one most easily formulated and is linked to a wide variety of query methods.

EXAMPLE: An item of information that might be required by the Commander is the number of tanks available. In a Command and Control battlefield automated system, the user/operator might translate the Commanders's requirement as follows:

DIS(play) # TANKS

b. A MODERATE query structure exhibits an average degree of complexity in retrieval requirements. This structural type is composed of two to three parameters or data items.

EXAMPLE: The user/operator may be required to retrieve information regarding availability of gun tubes on M60A1 tanks at supply points within a 50 mile radius. This request may be interpreted as follows:

PR(int) TANK, TUBE, AREA = WHISKEY

where WHISKEY is a code descriptor for a range of 50 miles radius.

c. A COMPLEX query structure is composed of four to five parameters or data items. As a result of the increased number of required interrelated items of information, this query type imposes a higher degree of complexity whereby construction becomes more complicated.

EXAMPLE: In planning for a forthcoming operation, the Commander desires to know how many rounds of HE could be delivered to the 8" batteries located within a specified area within the period from H to H + 2 hours from a designated ammo supply point. The user/operator of a particular command and control battlefield automated system might translate the Commander's requirement as follows:

```
PR(int)          ARTY = 8;
PR(int)          TYPE = HE;
PR(int)          LOC  = TANGO;
PR(int)          TIME = H, H + 2;
PR(int)          SUP  = ALPHA:



EX(ecute)
```

where TANGO is a code descriptor for the Commander's specified area.

d. An EXTREME query structure represents the most difficult data retrieval type to formulate. It consists of more than five parameters or data items and is aligned with a limited number of query methods.

EXAMPLE: A Commander of Armor Division has received a mission. During his planning, he must know how many armor personnel replacements will be available for assignment to tanks prior to H - 10 hours. If this number will be less than 75% of authorized strength, then he must find out how many personnel in the division have secondary armor MOSs and primary MOSs that will not be critically needed during the operation. The user/operator of a wartime personnel accounting system might use a preformatted "Fill-in-the-Blanks" input display to translate the Commander's requirement.

```
CATEGORY:  Replacements       TYPE:  tank
TIME:  h - 10       STRENGTH:  <75
UNIT:  div          PRIMARY:  c, cs
SECONDARY:  tank



*User/operator entries in lower case
```

5.2.3 BENEFITS OF QUERY STRUCTURE

The benefits which evolve from the use of query structures include the following:

a. Reduced error rates, by minimizing:

   1. Errors in data retrieval by operators of all skill levels.

   2. The number and difficulty of steps required to retrieve stored or filed data.

b. Increased system throughput rates, by minimizing:

   1. The time required for access to required information.

   2. The time required for utilization of data base information.

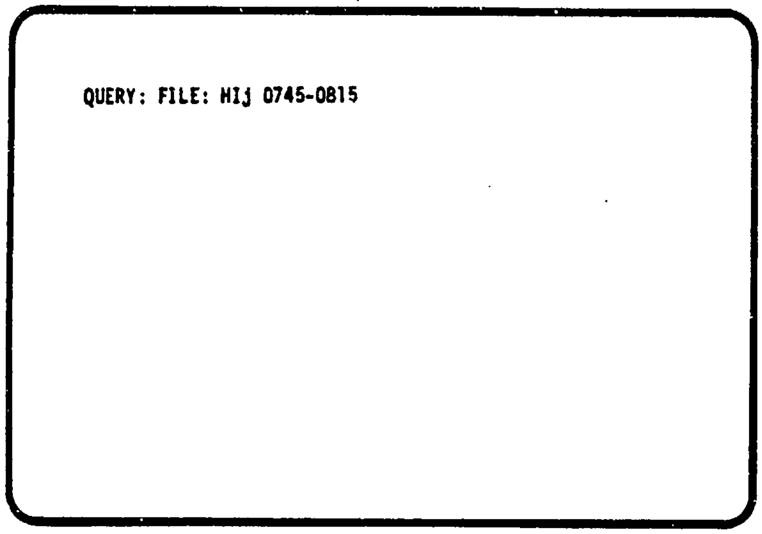
c. Increased training effects, such that:

   1. Minimally trained operators can perform the simple queries with acceptable facility.

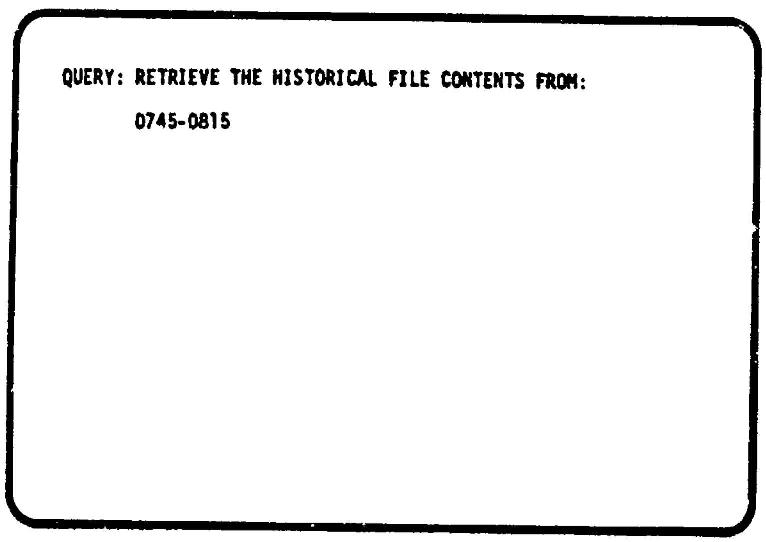
   2. Reduced complexity of training instructors and manuals for the query process can be achieved.

5.2.4 METHODS FOR USE WITH QUERY STRUCTURE

a. User-initiated query language dialog, in which the user/operator enters queries in response to a prompt symbol appearing on the terminal. The prompt is typically brief, so the user/operator must remember the query codes and options and accurately type them at the terminal.



b. Natural language dialog, which is typically user-initiated query language, in which the designer attempts to make the query language as much like standard English as possible.



c. Menu selection, in which the user/operator selects a desired command from a list of commands presented on the display. The user/operator then enters the code, word, or number associated with that command.

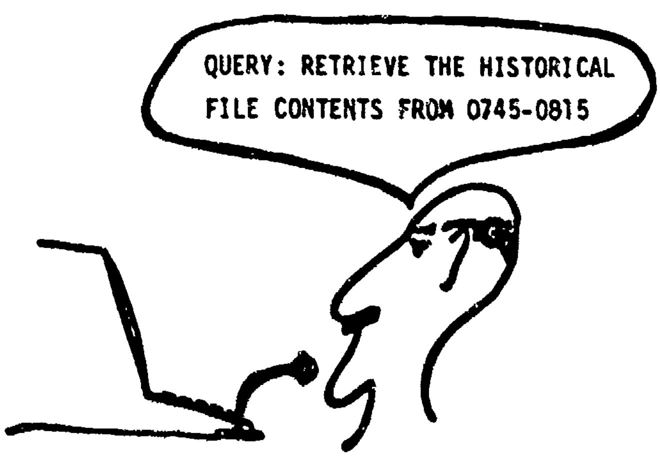
```
THE AVAILABLE RETRIEVE OPTIONS ARE:

     1. VOLATILE DATA FILE
     2. HISTORICAL DATA FILE
     3. FRIENDLY ARMOR LOCATIONS
     4. HOSTILE ARMOR LOCATIONS
     5. STANDARD REPORT FORMAT



ENTER DESIRED OPTION -->
```

d. Fill-in-the-blanks, in which the user/operator fills out a form or questionnaire presented at the terminal. The entries in the "blanks" may be words, codes, numbers, or merely symbols ("checkmarks" or "Xs") to indicate that the user/operator wishes to perform the operation displayed on the "form."

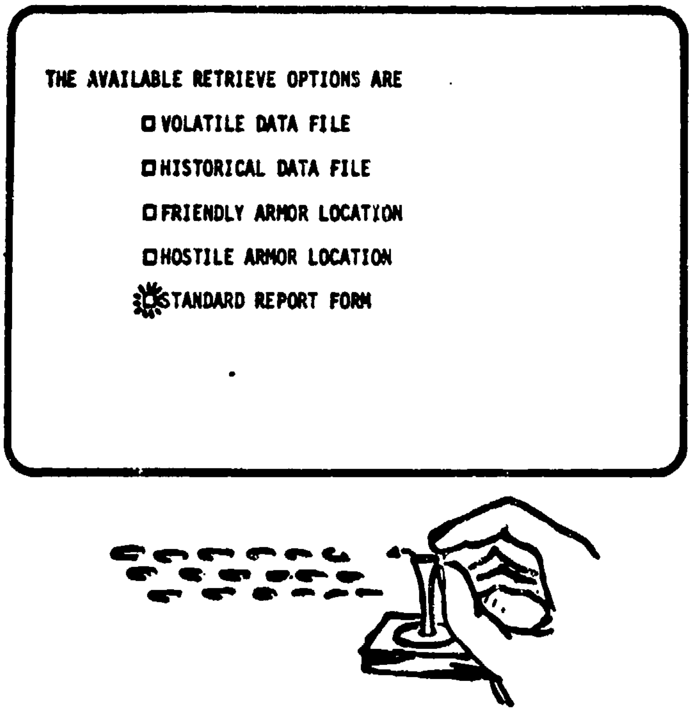
```
USER CODE NUMBER:______-__-___ ID NUMBER:_____-__
CHARGE CODE:___-__/__ DATA FILE DESIRED:______:__:__
ACTIVITY:           RETRIEVAL:__   EDITING:__
OPTIONS:____ ____
        ____ ____
        ____ ____
        ____ ____
HARD COPY DESIRED? (Y/N):__
```

e. Voice input query language, in which the user/operator enters the syntax and structure of the query language through the spoken voice, rather than keyboard or cursor.

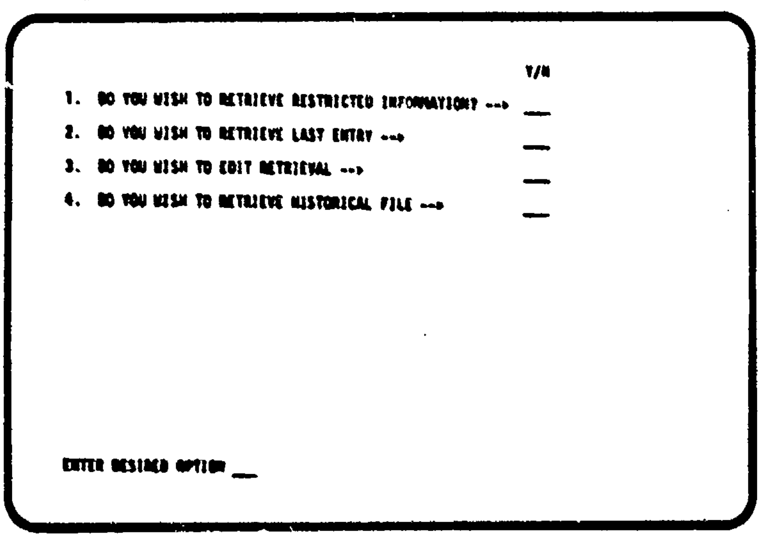
f. Voice input natural language, which is typically a form of user-initiated query language, where the user/operator speaks commands instead of typing them.



g. <u>Cursor control dialog,</u> which is usually a special form of menu dialog, in which the user/operator positions the screen cursor next to the desired command. The cursor may be moved with any graphic positioning device. In the example below, the user/operator is using a joystick.



h. <u>Question and answer dialog</u>, in which the computer system asks the user/operator specific questions. In the simplest form of this type of dialog, the user/operator may respond only with "Y(ES)" or "N(O)." In more complex forms, the user/operator may be required to respond with a number or a code for a query.



i. <u>Query command file,</u> which is typically user-built and initiated. The user/operator supplies some prompted information and then runs the file.

```
QUERY FILE:  3016 ARMOR BATTALION

     ENTER:  1.  NEW DESTINATION?
             2.  ETA?
             3.  ADDITIONS, DELETIONS
             4.  *                  ?
             5.  **                 ?
             6.  OUTPUT? ____________


RUN
```

j. <u>Query command macro,</u> relatively permanent routings initiated by the user/operator who supplies prompted parameters.

```
QUERY MACRO: ART: STATUS, HE, AP, ROUNDS
             ARTILLERY BATTALION(S)?
             ARTILLERY BATTALION(S)_______?
             ARTILLERY BATTALION(S)_______?
             ARTILLERY BATTALION(S)_______?


RUN
```

5.2.5 RECOMMENDATIONS FOR QUERY STRUCTURE

a. Table 5.2-1, Query Method by Complexity of Query Structure Type, presents a general list of recommendations for selecting the most effective query method or methods given the complexity of the query structure type. Before making a final decision, consult specific recommendations for individual query structures in Section 5.2.6.

To use the table, first decide what query structure (according to number of parameters) applies to the situation you are considering. Eliminate any query method where a "4" appears as an entry. Select the best query method by comparing the remaining types in view of the query structure you are formulating.

Table 5.2-1. Query Method by Complexity of Query Structure Type

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

		QUERY STRUCTURE (NUMBER OF PARAMETERS)			
		SIMPLE (1)	MODERATE (2-3)	COMPLEX (4-5)	EXTREME (5+)
METHOD	QUERY LANGUAGE DIALOG	1*	1*	1	1
	NATURAL LANGUAGE	1	1	1	1
	MENUS	1	2	3	4
	FILL IN THE BLANKS	2	2	3	3
	VOICE INPUT QUERY LANGUAGE	1	1	2	2
	VOICE INPUT NATURAL LANGUAGE	1	1	2	2
	CURSOR CONTROL DIALOG	2	3	3	4
	QUESTION & ANSWER DIALOG	1	1	2	2
	QUERY COMMAND FILE	2	2	1*	1
	QUERY COMMAND MACRO	2	2	1	1*

* Recommended as 1st choice for standardization purposes.

b. Provide multiple paths through a transaction to accommodate experienced as well as inexperienced users/operators. For example, in a menu-oriented system, allow inexperienced individuals to work through a sequence one menu at a time.

c. If a delimiter is required to distinguish optional parameters or separate keyed entries in a stacked command, use a standard symbol for that purpose, preferably the virgule (/) to separate the series of data entries.

5.2.6 ADVISORY COMMENTS ON QUERY STRUCTURE

The methods used in implementing query structures are the same methods used in determining compatability with characteristics of the system or system users. These methods have been discussed and illustrated in Sections 5.1.4 through 5.1.6 as well as in Sections 5.2.4 and 5.2.5. Query structure has been defined as relating to the complexity of the retrieval order itself and the suitability of the order with any of the query methods discussed. The suitability of the methods-structure pairing is shown in Table 5.2-1, Query Method by Complexity of Query Structure Type. No further discussion of methods will be attempted in this section; however, comments pertaining to the structure themselves will be presented. As the number of parameters required to effect a query increases, the suitability of some of the query methods decreases. Operability, end users, and the mission itself will all benefit, therefore, from increased time and effort spent to reduce the number of parameters per query. Some considerations for the structuring of queries include:

a. Provide parameter values that do not exceed 5 - 7 characters.

b. If parameter values can be abbreviated, provide abbreviations that do not require punctuation.

c. When a dimensional unit is constantly associated with a particular entry field, display the unit as part of the fixed label rather than having it entered by the user/operator.

d. Provide parameters whose definition is understood by the user/operator, not just the programmer.

e. Use special function keys for the input of critical parameters or partial parameter strings.

f. Provide common language nomenclature for parameter values, especially if unsophisticated users/operators are expected, due to high turnover, reassignment, limited training, etc.

g. If parameter values can be abbreviated, permit the use of any unambiguous abbreviation for the value.

h. If punctuation is required to separate multiple parameter values, use the virgule (/) as the delimiter.

i. Provide the user/operator with the option of selecting default values for certain parameter strings.

j. When multiple parameters are entered as a single transaction, provide the user/operator with the ability to restart, cancel, or change any item before taking a final enter action.

k. Provide the user/operator with a dictionary of abbreviations and codes, available on-line.

l. If codes are a necessary part of the parameter values, provide letter codes in mnemonic form rather than numeric codes.

SECTION 6. SYMBOLOGY AND TERMINOLOGY

This section addresses ways to assist users/operators in using symbols and terms to communicate with and through the system. Guidelines are concerned with symbol elements, their aggregation into units (e.g., terms, codes), and their presentation to the user/operator (e.g., glossaries). Symbology and terminology are considered within the following five categories:

1. Symbols and Symbol Sets describes techniques for selecting appropriate symbols/character elements.

2. Standard Terms describes conditions under which use of established, widely used terms is appropriate or even essential.

3. Abbreviations and Codes provides principles and techniques for formulating and using arbitrary representational words or other symbols.

4. Full Language describes conditions under which use of full language is appropriate or essential and provides guidance for such usage.

5. Glossaries describes techniques for providing guidance to the user/operator for accessing and understanding the relevant symbology and terminology.

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6.1 Symbols and Symbol Sets

6.1.1 DEFINITION

Symbols are single alphabetic, numeric, graphic, and pictorial elements; they are the fundamental units that users/operators employ to construct inputs to battlefield automated systems, and that systems employ to construct outputs to users/operators. Symbols may include any or all of the following:

a. Alphabetic symbols, comprising the 26 roman letters "a" through "z," used in either upper or lower case. The number of alphabetic elements may be expanded by using both upper and lower case, and by using two or more distinctive type fonts. Other letters (e.g., Greek or Russian) are considered to be special symbols, as described below. Roman numerals are a special case drawn from the normal roman letters.

b. Arabic symbols, comprising the 10 numerals Ø through 9.

c. Grammatical symbols, which are used in ordinary printing or writing, such as (,), (.), (/), (;), and (:).

d. Special symbols, comprising the signs associated with various branches of science and technology. Examples of special symbols are (σ) the Greek letter "sigma" used in statistics to denote the population standard deviation; (=) to mean "equal to" in mathematics, and ($\equiv$) to mean a "triple bond" or "negative charge" in chemistry.

e. Graphic symbols, abstract symbols assigned a particular meaning in a given application. ( ) used to denote infantry and ( ) used to denote armor units are examples of graphic symbols. Graphic symbols may be accompanied by alphabetic or numeric symbols for amplification (e.g., "xx" atop the symbol " " denotes an armor division, as opposed to, say, a corps or brigade).

f. Pictorial symbols, representational symbols used in graphics displays. Examples of pictorial symbols are ( ) stick figures used in a histogram (bar chart) to represent available strength, or ( ) a simplified drawing of a cannon used on a map to depict artillery locations or strength.

Symbol sets are made up of the collection of symbols available in a given system for constructing inputs and outputs.

6.1.2 APPLICATIONS

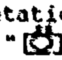
Each of the general types of symbols is used for a somewhat different purpose. Often, though not always, this utilization is obvious. In addition, different types of symbols are normally combined within a single symbol set. For example, the standard office typewriter and many computer terminal keyboards contain a "standard" alphanumeric symbol set consisting of the alphabetic, arabic, and grammatical symbols, plus a few of the special symbols (e.g., @, $, ¢, *, #). In general, symbol types are utilized as follows:

a. Alphabetic symbols are used to form plain language words (e.g., "soldier," "bridge," "tank," "carburetor"); abbreviations (e.g., "Arty," "CPT," "Trk," "Div"); acronyms (e.g., "BETA," "USAREUR," "FEBA"); and some types of codes (e.g., "TACFIRE," "HHC," "ECM").

b. Arabic symbols are used most often to express numerical quantities such as counts or distances. Frequently, they are also used as codes. Telephone numbers, ZIP codes, equipment designators, target designators, and identifiers for menu options on a display are examples.

c. Grammatical symbols are normally used as punctuation in plain language text portions of system inputs and outputs. They are also used sometimes as field and subfield delimiters in preformatted displays. For example, the date field on a CRT might be displayed as "DATE: 11/16/81."

d. Special symbols are used to indicate mathematical relationships or other forms of "shorthand." For example, a request to show all battalion-level units that currently are less than 80% of authorized personnel strength might be expressed as "SHOW BN < 80% PERS."

e. Graphic symbols are used to represent objects or quantities when precise detail is not required and the symbols will conserve space, add meaning, or speed interpretation of a display. For example, on a map display the symbol "" conveys the location of an armor division at a glance, though it provides no detail such as strength or fuel status.

f. Pictorial symbols serve much the same purposes as graphic symbols. However, they generally are less abstract and therefore less ambiguous than graphic symbols. Pictorial symbols are consequently more appropriate for naive users/operators in situations that do not require detail or precision than for experienced users/operators who do not need so much detail.

6.1.3 BENEFITS

The initial benefit of symbols and symbol sets, of course, is that they enable communication between users/operators and battlefield automated systems. Careful selection of symbols and symbol sets provides additional benefits, including:

a. Efficient intrasystem and intersystem communication through reduction of need for routines to translate the symbols of one workstation or system to that of another workstation or system.

b. Reduced time required for users/operators to complete transactions with the system, thereby reducing throughput time.

c. Reduced user/operator error rates, thereby reducing contamination of data bases and erroneous products; also contributes to reduced throughput time by reducing error detection, diagnostic, and correction procedures.

6.1.4 METHODS

Methods which can be used for selection of symbols and symbol sets include:

a. Use of standard terminal keyboards which provide the standard alpha and numeric symbols and the more usual grammatical symbols. These keyboards can frequently accommodate a few special symbols. Utilization of common terminals across system positions and across systems provides terminals with identical symbol sets. Even when different terminals are used, terminals with consistent symbol sets can be selected.

b. Use of off-the-shelf keyboards which permit incorporation of additional grammatical symbols, special symbols, and graphic symbols.

c. Software can be used to generate symbol sets. For example, software is frequently used to define map symbology in automated cartographic applications.

d. Users/operators may be required to generate graphic symbols on terminals which allow this, e.g., in interactive computer graphics applications.

6.1.5 RECOMMENDATIONS FOR SYMBOLS AND SYMBOL SETS

6.1.5.1 Selection of Symbol Sets

a. Selection of symbols and symbol sets is dependent upon the type of usage intended and the variability of that usage. The selected symbol set must be adequate to fulfill--but not exceed--the most complicated/sophisticated usage required. Table 6.1-1 provides guidance on the types of symbol sets required for different task requirements. As these requirements become more diversified at a given user/operator position, the symbol set requirement may become more diversified. If, for example, the user/operator uses a menu from which to select a special technical content report format, display of the menu makes provision of the upper case alpha symbol set mandatory and, depending upon requirements, may not make the numeric symbol set necessary. By calling up the special technical report format, any of a number of symbol sets may or may not be required (lower-case alpha, numeric, standard grammatical, nonstandard grammatical), but the set of special symbols appropriate to the technical area would be required.

Table 6.1-1. Types of Symbols Required by Application

1 = Required
2 = Probably required
3 = Most probably not required

PURPOSE/TASK	SYMBOLS PROVIDED BY KEYBOARD						GRAPHIC SYMBOL GENERATION CAPABILITY
	UPPER CASE ALPHA	LOWER CASE ALPHA	NUMERIC	STANDARD GRAMMATICAL	NONSTANDARD GRAMMATICAL	SPECIAL TECHNICAL PURPOSE	
Menu Item Display/Selection	1	3	2	3	3	3	3
Query Methods	1	3	2	3	3	3	3
Fixed Format Alphanumeric Message Display/Completion	1	3	1	1	3	3	3
Variable Format Alphanumeric Message Display/Completion	1	3	1	1	3	3	3
Free Text Message Completion	1	2	2	1	2	3	3
Report Generation/Display	1	2	2	1	2	3	3
Special Technical Content Report Generation/Display	1	2	2	2	2	1	3
Graphic Message Generation/Display	2	2	2	2	2	2	1
Special Technical Graphic Message Display/Generation	2	2	2	2	2	1	1

b. When alphabetic data entry is required, restricted alphabetic symbol sets should not be used.

c. When special characters are used (@, *, +, #, etc.) particularly if they are used frequently, they should be chosen, to the extent possible, to avoid shifting from one case to another on the keyboard.

6.1.5.2 Symbology Definitions

a. When symbols are used separately or in text, they should have a specific definition suited to that application. Grammatical and other symbols retain a meaning acquired through standard usage, i.e., a "population stereotype." When these symbols are incorporated into the user-computer interface language, meanings acquired in other usage should be considered and retained to the extent possible.

b. If a choice of symbols is available, use the simplest one possible. Take into consideration the following aspects:

   1. Elimination of confusion between one symbol and another.

   2. Naturalness of the symbol to represent an idea or an object.

c. When used as mathematical operators or as message delimiters, standard symbol usages should apply, as shown in Table 6.1-2.

Table 6.1-2. Generally Accepted Usages for Standard Symbols

SYMBOL	LABEL	CONVENTIONAL USAGE	RECOMMENDED USER-COMPUTER INTERFACE USAGE	
			FIXED FORMAT MESSAGE	MATHEMATICAL APPLICATION
.	Period	At the end of a declarative sentence; following an abbreviation; before a decimal, between dollars and cents.	Not recommended for use.	Use in conventional sense, i.e., before a decimal, between dollars and cents.
,	Comma	Sets off a phrase; separates word series and phrase series; separates numbers in dates, as in January 24, 1982.	Use as a multi-valued field delimiter to separate individual and comparable entries.	Use to separate series of numbers
/	Virgule or slash	Separates alternatives, as in and/or; used to represent "per" as in miles/hour.	Use as within field delimiter of separate individual but different entries.	Use as an arithmetic operator to indicate division.
:	Colon	When the colon follows a word it introduces a quotation, an explanation, an example, or a series of things; used between numbers in expressions of time (02:30) or to express ratios (2:1).	Use in time entries to separate 2-digit indications of hour, minutes, seconds: (08:30:10).	Use to indicate ratios.
;	Semi-colon	Used to separate parallel expressions; separates successive phrase elements; acts as a strong comma or a weak period.	Use as the end of a data field delimiter.	Not recommended for use.
-	Dash or minus	Sets off a parenthetical clause; indicates an omission, indicates a break in thought; indicates a subtraction; indicates a negative value (e.g., -15°F).	Use to indicate spaces not available for data entry; use to indicate negative values.	Use as an arithmetic operator to indicate subtraction
+	Plus sign	Indicates an addition; indicates a positive value (e.g., +15°C).	Use to indicate positive values.	Use as an arithmetic operator to indicate addition.
°	Degree sign	Indicates a unit division of a temperature scale; indicates a unit of latitude or longitude, indicates a unit of angular measure.	Use in the conventional senses. The context will make the meaning clear.	Not applicable.
_	Underscore	Sets off a symbol or set of symbols and indicates emphasis.	Use to indicate spaces that are to be used for data entry.	Not recommended for use.
?	Question	Used at the end of a sentence that is an inquiry inviting a reply.	Use in menu/query format to indicate a reply is required.	Use in mathematical expressions to indicate an unknown quantity.
*	Asterisk	Used in writing to indicate an omission; used as a reference to a footnote.	Use to set off/highlight data entries.	Use as an arithmetic operator to indicate multiplication.
!	Exclamation point	Used after an exclamation, i.e., an abrupt utterance or outcry, following a number, indicates the factorial of that number, (the product of all the positive integers from 1 to that number, e.g., 4! = 1x2x3x4=24).	Use to indicate the end of message.	Use in mathematical expression to indicate a factorial number.

6.1.5.3 Symbol Discriminability

a. The recognizability of individual symbols is affected by such factors as stroke width, slant, brightness, and the number of symbols displayed. In order to make symbols as distinct from each other as possible, the design of individual symbols should attend to the following:

1. Capital letters are the most easily recognized individual symbols. (Capital letters are enormously overlearned from early childhood on.)

2. Letters such as A, B, E, F, P, R, should have a clearly delineated space above the horizontal stroke.

3. C and G are easily confused with each other if the horizontal stroke on the G is not long enough.

4. D and O are easily confused unless the O is very rounded and the D is somewhat squared.

5. U and V are easily confused unless the U is squared and the bottom angle of the V is very sharp. A long vertical center stroke on the Y eliminates confusion between Y and V.

6. Considerable confusion is possible between "l" (the lower case L), the upper case "I," the number "1," and the number "7." A numerical configuration such as shown in Figure 6.1-1 can overcome most of these problems, especially when a segmented numeral configuration is possible.

*

Figure 6.1-1. Proposal for Improved Seven-Segment Numeral Configurations

Note that the above numerals incorporate the following characteristics:

(a) A slant of 15 - 20 degrees, clearly distinguishing numbers from letters if vertical letters are used.

(b) Accentuation (50% increased stroke width) of some strokes (the left vertical strokes and the middle and lower-horizontal strokes).

---

*Van Nes, F. L. and Bouma, H. On the legibility of segmented numerals. *Human Factors*, 1980, 22(4), 463-474.

(c) Increased length of horizontal segments to achieve a height to width ratio of 1.5:1.

b. Slanting of numbers (versus vertical letters) eliminates confusion between the number "5" and the letter "S" and between the "l" (the lower case L) and the number "1." Unless the upper case "I" carries the top and bottom serifs, confusion between the "l" (the lower case L) and the upper case "I" will be sustained. If segmented/slanted numbers are not used, the following constructions will help to eliminate confusions:

1. | = the number "one"

2. 7 = the (European) number "seven"

3. l = the lower case "L"

4. I = the upper case "i"

c. Confusion between the upper case "O" and the "zero" numeral can be eliminated by a slant through the zero:

1. O = the letter "O"

2. Ø = the number "zero"

6.1.5.4 Type Characteristics

a. In general, normal type fonts available on standard keyboards (typewriters, for example) are of roughly equivalent legibility. Overly ornate fonts, such as Old English (also called black letter) and script, should be avoided.

b. For printed material to be viewed at comfortable book reading distances, 9-point to 12-point type (.125 inch to .167 inch height) is best. (Type font height is measured by the height of the lower case "x" symbol.) Larger type is useful for emphasis or when distance or other factors present perceptual problems.

c. For noncontextual searching applications on a CRT display which uses stroke-generated characters, variations of character size within a range of .12 to .16 inch are appropriate. (Note that these are almost identical to the optimum size for printed materials.) If space on the screen is at a premium, even smaller size type (6.6-point/.09 inches) is adequately legible.

d. The optimum height of letters in a raster-type CRT display is about 9 to 10 raster lines. Optimum width of characters is about 75 percent of character height. Optimum character height ratios vary with the figure-ground contrast. A ratio of 1:5 to 1:10 is appropriate for black letters on an illuminated

background; 1:8 to 1:10 is appropriate for illuminated letters on a dark background; and 1:12 to 1:20 is appropriate for highly illuminated letters.

e. For numerals, optimum character height to stroke width ratios are in the range of 4:1 to 6:1 when printed materials are used. These same ratios appear to be appropriate for raster-type CRT displays.

f. When a large amount of text is to be entered or read, appropriately intermixed upper and lower case characters are easier to read than all upper case characters. In these instances, normal grammatical construction rules are to be followed and grammatical symbols are required, as well as both upper- and lower-case alphabet symbols. In some cases, however, the use of all upper-case letters can be justified:

1. For emphasis.

2. For greater legibility at distances.

3. To display key alerting words or phrases.

4. To display target words in a list of terms.

5. In scanning situations.

6.2 Standard Terms

6.2.1 DEFINITION

Standard terms are those full word conventions which provide consistent terminology to be employed in user/operator interaction with the system. A subset of the full language standard terms provides terminology appropriate to a given area of science or technology. They may be "coined" words (such as TACFIRE), acronyms (such as FEBA), or universally accepted codes or abbreviations (such as Hz for hertz), use of which is so frequent and so conventional in a given context as to render them as well known and understood to their user population as full language. This complete absorption into their users' vocabulary is one characteristic that distinguishes these terms from codes and abbreviations. (See Section 6.3, Abbreviations and Codes.)

6.2.2 APPLICATIONS OF STANDARD TERMS

Standard terms may be used as:

a. Commands input to the system by the user/operator to control the system (as described in Section 1.1, Alphanumeric Control Methods).

b. Menu items presented by the system to guide the user/operator in interacting with the system (as described in Section 1.3, HELPs).

c. Text content to fill message formats (as described in Section 2.1, Alphanumeric Displays).

Specific applications for standard terms include:

a. To provide terminological consistency within a given system for:

   1. Within-process sequences.

   2. Across-process sequences.

   3. Hard copy input/output information.

b. To provide terminological consistency across systems for such information as:

   1. Equipment descriptions and designators.

   2. Place names.

   3. Organizational descriptions.

   4. Echelon descriptions.

   5. Units of measure.

6.2.3 BENEFITS

Use of standard terms will result in the following benefits:

a. Efficient intrasystem and intersystem communication.

b. Unambiguous communication of information both within and between systems.

c. Reduced user/operator time and error.

d. Conservation of system storage and processing time.

6.2.4 METHODS

Methods which can be used for assuring utilization of standard terms include:

a. Reference to off-line sources of standard terms appropriate to the context. (See Section 6.5, Glossaries.)

b. On-line presentation of appropriate terminology from which the user/operator selects the appropriate term. Such presentation usually is in the form of a menu.

c. Implementation of evident and workable rules and procedures for generation and dissemination of system-unique terminology.

d. Built-in system checks which identify illegal entries. (See also Section 3.1, Information on Legal Entries and Section 7 on ERROR HANDLING.)

6.2.5 RECOMMENDATIONS FOR STANDARD TERMS

6.2.5.1 Term Selection

a. Select terms carefully and in a consistent fashion to assist the user's task and to support training. For example, when dealing with "minimum" and "maximum" concepts, standard usage of "MIN" and "MAX" communicates clearly, consistently, and concisely.

b. Use shorter rather than longer terms if there is a choice. Strive for a limit of 5 - 7 characters per word. Errors increase with longer words.

c. Take advantage of the hierarchical structure of language. For example:

    TERRAIN
        NATURAL FEATURES
            Cave
            Depression
            Hilltop
            Lake
            Marsh/swamp
            Ridge
            River
            Stream/creek
            Valley
        MAN-MADE FEATURES
            Cemetery
            Crossing, railroad
            Crossing, river
            Junction, railroad
            Junction, trail
            Railroad track
            Road
            Trail

d. Avoid difficult terms that are not commonly used by all users. Choose terms (for example, for command language or for data entry) that reflect the user's point of view and not the programmer's. A basic rule for programmers and system designers should be: Know the users and adapt terminology to their vocabulary instead of vice versa.

e. When Army "doctrine" provides terms appropriate to a given context, incorporate these terms into the usage context. In the event of doctrine usage, provide a way to integrate new doctrinal terms into system usage as these become available or to reflect changes in doctrinal terminology as these are made.

f. Select terms that have intrinsic meaning to the user. For example, military time is expressed in terms of a 24-hour clock rather than by two 12-hour clocks.

6.2.5.2 Term Usage

a. All terms should be used consistently and should be standardized in meaning from one transaction to another, one task to another, and--to the extent possible--one context to another. For example, do not use EDIT, MODIFY, and UPDATE interchangeably. If all are to be used, make sure their usage is distinct and clearly defined to the user. (See Section 6.5.5, RECOMMENDATIONS FOR GLOSSARIES for examples of specific distinctions among sample command terms.)

b. Use as few terms as possible. Avoid special terms for special cases if more general terms will suffice.

c. When usage is common to two or more presentations, maintain consistent and uniform wording. A display called up by selection of a menu option should maintain the wording of the menu option in the title of the display. For example:

USE

```
IN WHAT TYPE OF EQUIPMENT ARE YOU INTERESTED?

    1.  CO --- COMBAT EQUIPMENT
    2.  AI --- AIR EQUIPMENT
    3.  TR --- TRANSPORTATION EQUIPMENT
    4.  EN --- ENGINEERING EQUIPMENT
    5.  etc.

--> CO
```

```
IN WHAT TYPE OF COMBAT EQUIPMENT ARE YOU INTERESTED?

    1.  ARM --- ARMORED EQUIPMENT
    2.  CMD --- COMMAND AND CONTROL EQUIPMENT
    3.  INF --- INFANTRY EQUIPMENT
    4.  etc.

--> ARM
```

DO NOT USE

```
IN WHAT TYPE OF EQUIPMENT ARE YOU INTERESTED?

    1.  CO --- COMBAT EQUIPMENT
    2.  AI --- AIR EQUIPMENT
    3.  TR --- TRANSPORTATION EQUIPMENT
    4.  EN --- ENGINEERING EQUIPMENT
    5.  etc.

--> CO
```

```
IN WHICH OF THE FOLLOWING ARE YOU INTERESTED?

    1   ARM --- ARMORED EQUIPMENT
    2.  CMD --- COMMAND AND CONTROL EQUIPMENT
    3.  INF --- INFANTRY EQUIPMENT
    4.  etc

--> ARM
```

d. Word usage should correspond consistently to the user's/operator's operational language. Avoid jargon which is not the technical jargon of the user/operator. But retain jargon which is common to and is universally understood by a group of users/operators (AMMO for AMMUNITION, for example).

e. Explicitly define technical terms, terms that could take on more than one meaning, or terms that are used more specifically than in their usual meaning in the connotation in which they are used. Use the term <u>only</u> in the predefined connotation. For example, the term SCREEN should not be used to mean "display frame" in one usage and "menu selection alternative" in another.

f. Flexible usage of basic versions of terms may be allowed for experienced users/operators: "Y" for YES, "N" for NO, for example. However, casual and inexperienced users/operators should not even be advised of the availability of such options.

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6.3 Abbreviations and Codes

6.3.1 DEFINITION

Abbreviations and codes are the user's/operator's shorthand for communicating with and through the system. Abbreviations are derived from full words, i.e., they are formed using selected letters/characters of words--for example, "equip" for equipment. There exist conventional abbreviations which are widely accepted in general usage as well as in the military argot (e.g., CPT for Captain, Arty for artillery). Even with widely accepted standard abbreviations, variation in the use of upper and lower case letters and in punctuation is frequent and widespread, creating potential stumbling blocks for users/operators.

Codes are arbitrary symbolic representations of things or their names. They can be made up of alpha, numeric, and symbolic symbol sets, or any combination thereof. Examples of alpha, numeric, and grammatical symbol codes are: "AN/PSG-2," the equipment code for the TACFIRE Digital Message Device; "75Ø612," an octally presented fault code for TACFIRE indicating that the key generator was not ready to encrypt a message for transmission; and "SYS;INIT," a code label for the TACFIRE System Initialization Message format. Codes can be formed as acronyms--a word formed from the first letters of a series of words or from some first letter sets. For example, the TACFIRE Digital Message Device is more frequently known as the "DMD;" "COBOL" stands for COmmon Business Oriented Language; "BASIC" stands for Beginner's All-purpose Symbolic Instruction Code. Both of these two latter acronyms, and probably "CRT" (for Cathode Ray Tube), are better known than their full language titles.

Abbreviations, codes, and acronyms can all be mnemonics, i.e., designed in such a way as to resemble the full word(s) for which they stand, thereby assisting the user's/operator's memory function. It is sometimes difficult to distinguish between abbreviations and codes; efforts to do so, however, seem far less important than the consistency and appropriateness of their design. Table 6.3-1 provides some examples of abbreviations and codes and the use of mnemonics--demonstrating some similarities and differences in derivation and construction. The table is intended to demonstrate the need for application of code design guidelines (as, for example, those presented in subsection

6.3.5) rather than to attempt to reach a distinction between abbreviations, acronyms, and codes.

Table 6.3-1. Sample Abbreviations, Codes, and Mnemonics

Full Word or Phrase	Identifier Label	Label Classification
Equipment	EQUIP	Abbreviation
Equipment	EQMT	Mnemonic abbreviation or code
TACFIRE Digital Message Device	AN/PSG-2	Equipment code
Digital Message Device	DMD	Acronym
Division (mathematics)	DVN	Mnemonic abbreviation or code
Division (military)	DIV	Abbreviation
Artillery Division	DIVARTY	Code
Forward Edge of Battle	FEBA	Acronym
Forward Edge of Battle	FRLT	Code
Front Line Trace	FRLT	Acronym

Individual codes are often some combination of abbreviation, acronym, and arbitrary symbolic representation. Table 6.3-2 demonstrates this by showing the relationship of selected TACFIRE message labels to their full name.

Table 6.3-2. Relationship of TACFIRE Message Labels (Codes) to Their Full Language Names

MESSAGE TYPE			
Message Label	Category	Purpose	Label Classification
SYS;INIT	System	Initialize the System Message	Abbreviation/Abbreviation
AFU;DIR	Ammunition and Fire Unit	Message Directory	Acronym/Abbreviation
SPRT;AIRCOR	Support	Air Corridor Message	Mnemonic Abbreviation/Acronym
FM;FOCMD	Tactical and Technical Fire Control	Forward Observor Command Message	Code + Mnemonic Abbreviation
NNFP;RESFU	Non-Nuclear Fire Planning	Reserve Fire Unit Message	Acronym/Abbreviation + Acronym
MET;COMD	Meteorological	User Commands Message	Abbreviation/Mnemonic Abbreviation
ATI;CDR	Artillery Target Intelligence	Coordinate Report Message	Acronym/Abbreviation + Acronym
SURV;RE2	Survey	Two Point Resection Data Message	Abbreviation/Code
FSE;NDC1NU	Fire Support Element	Nuclear Burst Sighting Message	Acronym/Acronym + Code

Shape and color are two additional dimensions used for symbolic coding. These two dimensions can be combined to provide a very wide range of code elements. Typical examples of use of color and symbolic codes are in quantitative graphics--charts and graphs which present contrasting measures for a set of variables, e.g., the number of tanks assigned per division across a set of calendar years. (See also Section 2.2, Graphics Displays.)

6.3.2 APPLICATIONS OF ABBREVIATIONS AND CODES

Areas of application for abbreviations and codes include:

a. Cuing users/operators as to "next step" operation by specific instructions.

b. Assisting users/operators in initializing and operating the system.

c. Requesting the next step in an operation from the user/operator.

d. Displaying system output.

e. Presenting a message or graphics format into which the user/ operator must enter data.

f. Providing header information to identify a nonformatted message or report.

g. Providing labels and/or notations on graphics presentations.

h. Providing error indications--warning and instructional content.

i. Reducing the number of key strokes required for system control and data entry.

j. Reducing the amount of storage dedicated to system control.

k. Conforming to conventions, standards, and doctrine.

l. Reducing the intrasystem and intersystem communication burden.

m. Reducing the amount and/or density of information presented on a given display or page.

6.3.3 BENEFITS

Use of abbreviations and codes results in the following:

a. More efficient utilization of system storage and processing capabilities.

b. Increased intrasystem and intersystem communication.

c. Through reduction in presentation and product density, increased user/operator effectiveness and data handling capacity.

6.3.4 METHODS

Methods to enhance the use of abbreviations and codes include:

a. Selection of standard terminal keyboards which provide the standard alpha and numeric symbols and the more usual grammatical symbols from which a great proportion of abbreviations and codes are usually constructed.

b. Coordination of abbreviation/code development and terminal keyboard selection to facilitate abbreviation and code design and usage.

c. Incorporation of conventional/standard codes, especially those called out by doctrine.

d. Use of off-the-shelf keyboards which permit incorporation of additional grammatical symbols, special symbols, and graphic symbols to expand the code element set.

e. Incorporation of keyboards providing special symbols and terminals which allow generation of graphics, especially color graphics, to greatly expand the symbology coding capability.

f. Use of software to expand the symbolic symbol set.

6.3.5 RECOMMENDATIONS FOR ABBREVIATIONS AND CODES

Although abbreviations are frequently used as codes, their methods of construction and often their usage are very different from that of codes. Therefore, in providing recommendations for construction and application of abbreviations and codes, the following attend first to abbreviations and then to codes.

6.3.5.1 Recommendations for Abbreviations

a. Use abbreviations instead of full terms to:

   1. Reduce the amount of display area required or reduce the density of the display area.

   2. Reduce the amount of storage area required per item of information, thereby effecting increased system storage capacity.

   3. Reduce input, processing, and output times.

   4. Reduce input and output error.

b. Define a standard set of abbreviations and use them consistently. Good abbreviations are quickly, easily, and unequivocally:

   1. Associated with the terms they represent.

   2. Discriminated from other abbreviations within the particular system context.

c. Incorporation of standard and well accepted abbreviations is a primary consideration in their use. Such terminology becomes, in this instance, military argot and as such communicates perhaps even more effectively than the full language for which it stands. These terms are derived through a variety of methods for developing abbreviations and, because they are so widely accepted, do not require attention to or consistency in their formulation rules. The following examples demonstrate formulation of standard and well accepted abbreviations by different rules.

Abbreviation	Full Language Term	Formulation Rule
AMMO	Ammunition	Slang for ammunition and now a fully accepted term.
MAXALT	Maximum altitude	First 3 letters of each word.

Abbreviation	Full Language Term	Formulation Rule
MAXRNG	Maximum range	First 3 letters; deletion of vowels.
USAREUR	United States Army, Europe	Acronym using: first letters, first 2 letters, first 3 letters.

d. Use the following strategies for construction of abbreviations:

1. Simple truncation. Drop off letters from the right end of the word until the desired abbreviated length is achieved.

2. Truncation - Second letter out. Drop out the second letter from the left end of the word, then apply simple truncation until the desired abbreviated length is achieved.

3. Contraction - Vowels out. Retain the first letter on the left end of the word (vowel or consonant), remove vowels and the letters H, W, and Y until the desired abbreviated length is achieved. Supplement with simple truncation as necessary.

4. Contraction - Frequent letters out. Retain the first letter on the left end of the word and delete letters from right to left on the basis of elimination of highest frequency of occurrence until the desired abbreviated length is achieved.

e. Preferences of military user personnel for the above and for abbreviations presented in the Data Element Dictionary (DED) are shown in Table 6.3-3.

Table 6.3-3. Use and Preferences for Abbreviation Types

1 = Most preferred/best

5 = Least preferred/worst

FORMULATION TYPE	CODE-RELATED ACTIVITY		
	Preference Only	Decoding (Writing the original term from the abbreviation)	Encoding (Generation of abbreviation)
DED - Data Element Dictionary	5	5	2
Simple Truncation	2	1	1
Truncation - 2nd letter out	4	4	5
Contraction - Vowels out	1	3	3
Contraction - Frequent letters out	3	2	4

f. Do not abbreviate unless the abbreviation is significantly shorter or more meaningful than the full term. Lenth of term is an important factor in developing abbreviations. A good rule is to let the length of the abbreviation depend upon the term being abbreviated. Use the following lengths as guidance:

Number of Letters in Original Term	Number of Letters in Abbreviation
5	3
6 - 7	4
8 or more	5

g. On the whole, if display and presentation space can afford it, longer abbreviations, especially if they resemble the full term, will communicate better and will be less likely to be confused than shorter abbreviations. Avoid abbreviations the user is not likely to understand or remember just to make more room for data on the display.

h. Taking the construction strategies and the recommended length into consideration, the sample abbreviations shown in Table 6.3-4 are derived.

i. The methods for structuring/selecting abbreviations can be applied in the following hierarchical sequence:

1. Incorporation of conventional, known, and well accepted abbreviations, especially in light of user/operator experience.

2. Simple truncation in accordance with the structure and length defined above.

3. The truncation - vowels out method and length as defined above.

j. It is not necessary and is inappropriate to form all abbreviations using only a single formulation method. Good judgment will promote the development of appropriate and well accepted abbreviations.

k. Learnability of abbreviations contributes to reduced user/operator error and increased system efficiency. Factors which contribute to learnability of abbreviations include:

1. Utilization of standard and familiar abbreviations.

2. Construction in conformance with user/operator preference.

3. To an appropriate extent, consistency in the method(s) applied in the design of abbreviations.

Table 6.3-4. Examples of Abbreviations Formed by Different Abbreviation Methods

Term	Standard Artads DED	Simple Truncation	Truncation 2nd Letter Out	Contraction Vowels Out
AMMUNITION	AMMO	AMMUN	AMUNI	AMMNT
ARTILLERY	ARTY	ARTIL	ATILL	ARTLL
AUTHORIZED	AUTH	AUTHO	ATHOR	ATRZD
BATTALION	BN	BATTA	BTTAL	BTTLN
BRIGADE	BDE	BRIG	BIGA	BRGD
"DISTRIBUTEES"	DISTR	DISTR	DSTRI	DSTRB
EQUIPMENT	EQUIP	EQUIP	EUIPM	EQPMN
HEADQUARTERS	HQ	HEADQ	HADQU	HDQRT
LOCATION	LOC	LOCAT	LCATI	LCTON
ORDNANCE	ORD	ORDNA	ODNAN	ORDNN
PLATOON	PLT	PLAT	PATO	PLTN
REINFORCEMENT	RNF	REINF	RINFO	RNFRC
RESTRICTION	RESTR	RESTR	RSTRI	RSTRC
ROUNDS	RDS	ROUN	RUND	RNDS
SECURITY	SCTY	SECUR	SCURI	SCRTY
SQUADRON	SQD	SQUAD	SUADR	SQDRN
SURVEILLANCE	SURVL	SURVE	SRVEI	SRVLL
TARGET	TGT	TARG	TRGE	TRGT
UNKNOWN	UNK	UNKN	UKNO	UNKN

4. Attention to the uniqueness/discriminability of abbreviations.

l. Except for abbreviations which have become so common as to be recognized as full words (e.g., AMMO for AMMUNITION), avoid using them in output. If it is necessary to use less familiar abbreviations in output, they should be distinct and unambiguous within the use context.

m. Allowable usage of abbreviations should not exclude usage of the full words. For example, experienced users probably prefer an abbreviation rather than the full word in making command entries; inexperienced users probably prefer to have the option of using the abbreviation or the full command term.

n. If the use of abbreviations is permitted in the construction of full text reports, provide software to expand these abbreviated terms to full language when the report is presented as output.

o. Use all upper case letters for abbreviations.

p. Avoid punctuation within abbreviations to the extent possible. In particular, do not use periods if they can be avoided.

Use	Do Not Use
USAF	U.S.A.F.
4 in front dimension	4-in. front dimension
USAREUR	U.S. Ar. Eur.

6.3.5.2 Recommendations for Codes

a. Control needs to be exercised over the design of codes. The following conditions contribute to this control:

   1. Codes are designed by code design experts.

   2. Maintain consistency in the code design strategies applied. Centralized control of code design enhances consistency.

   3. Design codes in accordance with user capabilities and limitations.

   4. Pay attention to tradeoffs between design for optimum human code usage and maximum machine handling capabilities.

   5. A clear understanding of the rules applied in code construction is essential.

b. Good code design takes three aspects into consideration:

   1. Human considerations - the acceptability of the code and the relationship of code design to user/operator code usage for:

      (a) Perceiving codes.

      (b) Interpreting codes.

      (c) Responding to codes.

      (d) Learning codes.

      (e) Entering codes.

      (f) Discriminating codes from each other.

   2. Machine considerations - the relationship of the code design to processing capabilities and capacities such as:

      (a) Storage and handling capacities.

      (b) Error tolerance.

      (c) Error correction strategies.

      (d) Interchangeability of information.

   3. Code design considerations - the relationships of code design strategies and options to human and machine capabilities and capacities, including:

(a) Available symbols and symbol sets.

(b) Existing codes and abbreviations which have become standard in a given context.

(c) The amount of information to be coded.

(d) The expandability/rigidity of the code set(s).

c. Design codes for the anticipated users/operators with the least experience and/or the lowest skill level.

d. For codes which will be used extensively, use only symbols which are very familiar to the anticipated users/operators.

e. Take user/operator preferences into account in designing codes. Some known user/operator preferences include:

1. Alpha characters rather than numeric.

2. Numeric characters for data which can be so represented. Example: for the date "24 January 1982," use "01/24/82" rather than "JAN/24/82" or JA/24/82."

3. Codes which are all alpha or all numeric, rather than mixed alphanumeric codes.

4. In general, use shorter rather than longer codes. (But, see also items h, j, l, and m.)

f. Break longer codes into "chunks." For example: "046-342-7932" for a telephone number rather than "0463427932." Or, "MAX ALT" rather than "MAXALT" for "Maximum altitude."

g. Make as strong a relationship between the code and its root meaning as possible. Dropping vowels and forming mnemonics help greatly in this instance. For example: "TNK BRDG" for "Tank Brigade." Mnemonic codes which conform to population stereotypes are excellent. These codes are quickly recalled and recognized and are unambiguous. Some examples are:

Code	Full Term
AMMO	Ammunition
EQUIP	Equipment
HQ	Headquarters
TGT	Target
TNK	Tank
UNK	Unknown

h. If meaningless arbitrary codes must be used--either all alpha or all numeric--make the codes no longer than four or five characters.

i. If meaningless arbitrary codes must be composed of both alpha and numeric symbols, group alpha characters together and numeric symbols together. For example: use "WC4," not "W4C."

j. When abbreviated codes are used to shorten data entry, make the codes as distinctive as possible. For example: "REM" versus "BAL" is good and "BAL" versus "BAS" is bad. On the other hand, however, in forming codes for a series of word combinations, maintain code consistency to the extent possible. For example:

Code	Full Term
AMOE	Ammunition expended
AMOH	Ammunition on hand
AMOR	Ammunition received

k. In dealing with codes for both entering and interpreting information, users/operators will usually deal with codes from a variety of code sets. (For example, codes for equipment, locations, quantities, date/time, etc.) Therefore, employ code design strategies which are:

1. Consistent enough to provide uniformity of design.

2. Different to the extent required to provide discriminability of codes.

l. Single letter or single numeric codes are not usually good for making discriminations since their meaning and even their identification can be very ambiguous. One exception to this, however, is the use of a single numeric as a menu selection indicator. For example:

```
                FILE OPERATIONS MENU

SPECIFY THE FILE OPERATION YOU WISH TO PERFORM

    1. (AP)PEND OR ADD TO A FILE

    2. (DE)LETE A FILE

    3. (DI)SPLAY A FILE




ENTER # OR LETTERS IN "( )" --->3
```

m. Longer codes can contribute to increasing code usage error for the simple reason of expanded memorization requirements. On the other hand, longer codes contribute to code discriminability. Therefore, tradeoffs between preventing errors (with shorter code) and creating errors (with longer codes) need to be considered. One rule to apply is to keep the symbol set(s) as small as possible in consideration of the code set(s) required, since the larger the "vocabulary" base from which codes are constructed, the more difficult the code learning/association process.

n. Single vocabulary (symbol set) code systems reduce user/operator error. However, as information sets become larger and more code sets are required, additional code vocabularies (symbol sets) are required to express meanings explicitly and unequivocally. If special symbol sets are required, use individual symbols which are easibly distinguished from one another.

o. Color can be used for special coding or to expand pictorial and even alphanumeric coding. When color is employed as part of coding, certain precautions are necessary:

1. Associate a single color with only a single meaning on a screen.

2. Make color associations as consistent and conventional as possible. Some standard meanings already attached to specific colors which are appropriate even when used on a green screen include:

Color	Meaning
Red	Alarms or data requiring immediate attention
Yellow	Warnings or data that may require attention
White	Highlighting detail

3. A maximum of 8 or 9 highly saturated colors can be easily discriminated.

4. Provide a "key" to color codes online.

p. Color added to shape codes as a redundancy increases recognition accuracy and reduces recognition time.

q. Colors are affected by lighting conditions. Low lighting reduces the discriminability of colors. Increasing brightness contrast increases color discriminability.

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6.4 Full Language

6.4.1 DEFINITION

Full language in this context is the use of conventional written or printed text for interaction with and through the system. Standard rules and operations of grammar and syntax apply; presentation conventions relevant to a body of scientific or technical information are also employed when appropriate.

6.4.2 APPLICATIONS OF FULL LANGUAGE

Full language is used in the generation and presentation of unformatted system messages, message segments, and system reports. It can also be used to query and operate the system under certain software design configurations.

6.4.3 BENEFITS

Use of full language permits the following:

a. Versatility in the input and presentation of information.

b. A natural flow of information which facilitates rapid and unencumbered system operation.

c. A system output which can be formatted to any set of external standards.

6.4.4 METHODS

Methods which can be used for provision of full language capability include:

a. Use of standard terminal keyboards which provide the standard alpha and numeric symbols and the appropriate grammatical symbols.

b. Provision of keybaords which incorporate a set of symbols appropriate to a given area of science or technology, as these are required.

c. Use of software which processes full text.

6.4.5 RECOMMENDATIONS FOR FULL LANGUAGE

a. The primary rule of full text presentation is to make the language meaningful to the user.

b. Full language requires presentation of information in directly usable form. Do not require the user to make any translation (such as transposing, converting, interpreting, interpolating, etc.) into any other terms or units.

c. Make the information presented in full lnaguage text as "straight" as possible, i.e., deviod of humor, ridicule, or punishment. Avoid "anthromorphism," vernacular or dialectic language, and slang.

d. Output speed is associated with text utilization. If the terminal's output speed is less than normal reading speed (about 250 words per minute), more compact messages can be used. If the terminal speed is greater than 250 words per minute, full language is required.

e. In presenting textual material, minimize hyphenation of words. Text is more readable if hyphenations are avoided. The chance of incorrect hyphenation is also avoided.

f. Do not use contractions in textual presentations. For example, do not use "don't," use "do not."

g. When codes and abbreviations have been used in entering information which becomes incorporated into full language reports or other full language presentations, automatically convert the abbreviations and codes into full language. If such conversion is not automatic (i.e., handled by the software), make such conversion manually for inclusion into formal/standard reports.

h. Use standard punctuation in full language presentations.

i. In full language presentations, use terminology which is consistent, defined, and documented. For terms that are technical, that can take more than one meaning, or that are used more specifically than their usual meaning warrants, provide explicit definitions in the connotation used.

j. Assure that words assume meanings or connotations appropriate to the users/operators rather than to the programmer or system designer. Some ways to avoid the user/programmer confusion about given words include:

   1. Use only words the user/operator is likely to know.

   2. Use words that are not likely to be interpreted in many different ways or in ways other than the user/operator would know.

3. Use words to mean only a single thing and not different things in different contexts or in different stages of a dialog.

4. Use simple language to the extent possible. Avoid complex constructions.

k. In presenting text on a small screen, do not exceed 50 - 55 characters per line. On larger screens, break text into 2 columns of 30 - 35 characters per line. Separate columns by at least 5 spaces if the text is not right justified and by 3 or 4 spaces if it is right justified.

6.5 Glossaries

6.5.1 DEFINITION

A glossary provides a list and definitions of selected symbols and terminology associated with a restricted subject matter area. Glossaries can be of any size; they can be presented on-line through the system or off-line through a variety of mediums.

6.5.2 APPLICATIONS OF GLOSSARIES

Glossaries can be used to:

a. Identify a set of legal entries.

b. Identify the correct entry given a set of conditions.

c. Demonstrate correct structure and syntax of an entry.

d. Provide definition for abbreviated or coded output.

e. Assure the use of standard or proper symbology/terminology in:

   1. System control.

   2. Data entry.

   3. Message composition.

   4. Report generation.

f. Assist correct interpretation of displayed information.

6.5.3 BENEFITS

Availability of a glossary or a set of glossaries will result in the following benefits:

a. Efficient system operation.

b. Unambiguous intrasystem communication.

c. Reduced user/operator time and error, as well as reduced frustration.

On-line presentation of glossaries will enhance all of the above benefits above off-line presentation.

6.5.4 METHODS

Methods for assuring glossary availability and use include:

a. Presentation of standard terms (legal entries) in system HELP files.

b. Provision of glossary elements in menus and prompts.

c. Default incorporation of standard terms (legal entries) in report and message header and fields.

d. Presentation of standard terms and other glossary items in off-line documentation such as special job aids and user manuals.

6.5.5 RECOMMENDATIONS FOR GLOSSARIES

a. Compile a dictionary/glossary of all codes, abbreviations, symbols, and standard terms which are required by the user/operator. Provide glossaries both in hard copy documentation and on-line through software.

b. A primary rule for the presentation of glossaries--whether on-line or off-line--is that they are formulated so as to be accessible to the user/operator. Such a requirement may make more than one presentation of glossaries and/or other reference sources necessary. Some examples of different types of presentation include:

   1. Alphabetical listing of glossary terms and their definitions.

   2. Alphabetical lists of potential glossary terms which the user/operator might consider and through which are indicated:

      (a) The correct term (i.e., the term to be used).

      (b) Definitions of similar terms so that distinctions are drawn between terms.

   3. Hierarchical presentation of sets of information, as appropriate.

c. Glossaries demonstrate correct structure and syntax of data entries as well as the correct data entry.

d. Provide glossaries for the system's operational commands as shown in Table 6.5-1, Alphabetical Glossary of Commands; Table 6.5-2, Glossary of Commands organized by Operation; and Table 6.5-3, Glossary of Commands Organized by Potential Commands.

Table 6.5-1. Alphabetical Glossary of Commands

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
ABORT	Discontinue current operation.	ABORT ABRIDGE CEASE END HALT PAUSE QUIT STOP
ACCRUE	Accumulate a running total of incoming numeric data.	ACCRETE ACCRUE ACCUMULATE ADD SUM
ACKNOWLEDGE	Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE ANSWER MESSAGE REPLY
ACTIVATE	Activate a computer-controlled device.	ACTIVATE EXECUTE GO START
ADD	Accumulate a presented set of numeric values, summing to a total.	ACCRETE ACCRUE ACCUMULATE ADD SUM
ADJUST	Make changes to existing file or set of information.	ADAPT ADJUST ALTER CHANGE MODIFY
ADMIT	Accept nonstandard input.	ACCEPT ADMIT ENTER

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
APPEND	Append new information to an existing file or set of information.	ADD ADJOIN AFFIX APPEND ATTACH INCREASE INSERT
ALPHABETIZE	Arrange a set of data in an alphabetical sequence.	ALPHABETIZE SEQUENCE SERIALIZE
ARRAY	Make rectangular arrangement of data into rows and columns.	ARRANGE ARRAY BLOCK
ASSIGN	Set file space aside for special purpose.	ASSIGN DEDICATE
AUDIT	Call up numeric data for examination.	AUDIT AUTHENTICATE EXAMINE VALIDATE VERIFY
AUTHENTICATE	Establish data or set of information as genuine.	AUTHENTICATE VALIDATE VERIFY
AVERAGE	Calculate the arithmetic mean of a set of numeric data.	AVERAGE CALCULATE MEAN
BRANCH	Form an expansion to a file or set of information separate from the main part.	ATTACH BRANCH EXPAND FORK

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
BREAK	Stop print. Discontinue print of file or set of information.	ABORT BREAK DISCONTINUE STOP
BUILD	Define an output format.	BUILD FORMAT
CALENDAR	Print schedule/calendar.	CALENDAR SCHEDULE
CALL	Call up a function or processing routine.	CALL FETCH FILE FILE = FIND GET NAME
CEASE	End (stop) all operations.	ABORT CEASE END HALT QUIT STOP
CHRONICLE	Arrange a set of data in a historical sequence.	CALENDAR CHRONICLE SEQUENCE
CODE	Transform full language to coded information state.	CHANGE CODE TRANSFORM
COLOR	Add color to a displayed output.	COLOR INTENSIFY RECOLOR

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
COMBINE	Integrate one file or set of information with another.	ASSIMILATE COMBINE INTEGRATE JOIN MERGE
COMMENT	Add remarks to a file or set of information.	ADD COMMENT REMARK
CONDENSE	Condense a file or set of information.	ABRIDGE CONDENSE EXTRACT
CONNECT	Activate a peripheral unit.	ACTIVATE ACTUATE CONNECT EXECUTE
CONTINUE	Continue with current action.	CONTINUE
CONVERT	Change data into another measurement form.	CHANGE CONVERT TRANSFORM
COPY	Copy a file or set of information.	CLONE COPY DISK DUP DUPLICATE RECORD D RECORD T REPEAT REWRITE TAPE
COUNT	Determine the number of things in a series.	COUNT ENUMERATE NUMBER

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
DATE	Indicate date only of operation or event.	CALENDAR DATE DATE/TIME
DATE/TIME	Indicate date and time of operation.	CALENDAR DATE DATE/TIME
DECODE	Transform coded information to full text.	CHANGE DECODE TRANSFORM
DECREASE	Decrease a counter.	DECREASE SUBTRACT
DEFER	Postpone processing indefinitely.	DEFER DELAY HALT HOLD PAUSE POSTPONE
DELAY	Delay for stated amount of time.	DEFER DELAY HALT HOLD PAUSE POSTPONE
DELETE	Delete an existing file or set of information.	ABORT CLEAR DELETE DESTROY KILL LOGOFF OMIT PURGE REMOVE UNSAVE ZAP

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
DELIMIT	Set boundaries around a stated value.	BOUND DELIMIT LIMIT
DIRECTORY	Display index of all available files of information.	DIRECTORY DISPLAY FILES INDEX LIST SHOW
DISCLAIM	Deny the validity/authenticity of data or set of information.	DENY DISAUTHENTICATE DISCLAIM
DISCONNECT	Sever the connection between a peripheral unit and the CPU.	DISCONNECT UNDO
DISK	Store a file or set of information on disk.	COPY DISK DOUT FILE FILEOUT HOLD HOLD D KEEP RECORD RECORD D RETAIN SAVE STORE WRITE WRITE TO DISK W 2 DK
DISPLAY	Display a report or partial report on the screen.	DISPLAY SHOW
DIVIDE	Perform the mathematical operation of division.	DIVIDE SEPARATE

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
EDIT	Edit a file or set of information.	CORRECT EDIT UPDATE
ENTER	Admit information into the system.	ADMIT ENTER
EXCHANGE	Exchange one piece of information for another.	EXCHANGE MOVE SUBSTITUTE TRANSFER TRANSPOSE
EXECUTE	Call up and use a specific procedure/program.	EXECUTE RUN START
EXTRACT	Extract portion from file or set of information.	ABRIDGE CONDENSE EXTRACT
FILTER	Screen out specified types of information from a file or set of information.	FILTER SCREEN SEPARATE SORT
FIND	Find a designated portion of a file (i.e., data within a file).	FIND GET SEARCH SEEK
FORMAT	Define an input or output format.	BUILD FORM FORMAT INPUT OUTPUT REPORT WRITE

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
GET	Indicate a file or set of information to work with.	CONNECT DEFINE FETCH FILE FILE = FIND GET LOAD RECALL REQUEST SELECT USE
HELP	Lend assistance.	HELP
INCREASE	Increment a counter.	ADD ADVANCE INCREASE INCREMENT
INDEX	Display index of all files.	DIRECTORY DISPLAY FILES INDEX
INQUIRY	Request for indication of types of function needed.	CALL INQUIRY
INSERT	Insert new information in file or set of information.	ADD INSERT
INTENSIFY	Intensify the existing color of a displayed output.	CHANGE COLOR INTENSIFY RECOLOR
JOIN	Attach one file to the end of another file.	APPEND ATTACH JOIN

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
LOGOFF	Leave the system.	ABORT BYE DONE END EXIT LOGOFF OFF QUIT SIGNOFF STOP
LOGON	Enter the system.	BEGIN ENTER ID IDENT LOGON SIGNON USER
MERGE	Merge data in a file or set of information.	ADJOIN ADMIT CONCATENATE CONNECT INSERT JOIN MERGE
MODIFY	Modify a file or set of information to a certain specification.	ADAPT ADJUST ALTER CHANGE MODIFY
MOVE	Move information within a file or set of information.	EXCHANGE MOVE TRANSFER TRANSPOSE
MULTIPLY	Perform the mathematical operation of multiplication.	EXPAND MULTIPLY

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
NEWFILE	Create a new file or set of information.	CREATE FILE FILE = FILEOUT NEW NEWFILE
NUMBER	Assign sequential numbers to things in a series	COUNT ENUMERATE NUMBER
OMIT	Exclude a piece of information from a report.	DELETE DESTROY OMIT REMOVE
OVERPRINT	Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT OVERWRITE PRINT WRITE
PAGE AHEAD	Page forward.	CARRIAGE RETURN FORWARD NEXT PAGE PAGE AHEAD
PAGE BACK	Page backward.	BACK BACKWARD PAGE PAGE BACK PAGE BACKWARD PREVIOUS
PAUSE	Stop temporarily.	HALT PAUSE POSTPONE
PRINT	Print a hard copy.	COPY LIST LP = OUTPUT PRINT WRITE

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
PROTECT	Protect a file or set of information.	PRESERVE PROTECT READ SAVE
RECOLOR	Change the color of a displayed output.	CHANGE COLOR RECOLOR
REPLY	Request a reply from the CPU or another terminal.	ANSWER REPLY RESPOND
REMOVE	Delete a piece of information from a file or set of information.	DELETE DESTROY OMIT REMOVE
SAVE	Store a file or set of information	RECORD SAVE STORE
SCREEN	Screen out specified types of information to be assimilated in a file or set of information.	FILTER SCREEN SEPARATE SORT
SEARCH	Find designated file.	FIND GET SEARCH SEEK
SELECT	Select and activate a computer-controlled device.	ACTIVATE ACTUATE AFFIX ATTACH CONNECT EXECUTE GO SELECT

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
SEPARATE	Arrange data into two or more files or sets of information.	ARRANGE DIVIDE SEPARATE SORT
SEQUENCE	Arrange a set of data in a causal-results sequence.	ARRAY ARRANGE SEQUENCE SERIALIZE
SERIALIZE	Arrange a set of data in a specified sequential order.	ARRANGE ENUMERATE NUMBER SEQUENCE SERIALIZE
SHOW	Display the content of a field.	DISPLAY LIST SHOW TERMINAL TO = VIEW WRITE W 2 TO
SORT	Sort data in a file or set of information.	ARRANGE ARRAY ASSORT ORDER SEQUENCE SORT
STATUS	Get system status.	GET STATUS SYSTAT
SUBTRACT	Perform the mathematical operation of subtraction.	DELETE REDUCE SUBTRACT

Table 6.5-1. Cont'd

RECOMMENDED COMMAND	OPERATION	POTENTIAL COMMANDS
SUM	Calculate the sum of a set of numbers.	ACCRETE ACCRUE ACCUMULATE ADD SUM
TELL	Notify user/operator at another terminal of a condition or event.	ADVISE APPRISE NOTIFY TELL
TRANSCRIBE	Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	SAVE TRANSCRIBE TRANSFER WRITE
TRANSFER	Move information from one file to another.	EXCHANGE MOVE TRANSCRIBE TRANSFER TRANSPOSE
TRANSPOSE	Exchange the order (sequence) of two pieces of information within a file.	EXCHANGE MOVE TRANSFER TRANSPOSE
VALIDATE	Prove as true by presenting other/detailed information.	AUTHENTICATE CONFIRM VALIDATE VERIFY
VERIFY	Substantiate truth or authenticity by expertise.	AUTHENTICATE CONFIRM VALIDATE VERIFY
WAIT	Wait for input.	DELAY HOLD WAIT
WRITE	Write a file or set of information on tape.	COPY HOLD T RECORD T SAVE TAPE TAPEOUT TOUT WRITE WRITE TO TAPE W 2 TP

Table 6.5-2. Glossary of Commands Organized by Operation

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Discontinue current operation.	ABORT ABRIDGE CEASE END HALT PAUSE QUIT STOP	ABORT
Accumulate a running total of incoming numeric data.	ACCRETE ACCRUE ACCUMULATE ADD SUM	ACCRUE
Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE ANSWER MESSAGE REPLY	ACKNOWLEDGE
Activate a computer-controlled device.	ACTIVATE EXECUTE GO START	ACTIVATE
Accumulate a presented set of numeric values, summing to a total.	ACCRETE ACCRUE ACCUMULATE ADD SUM	ADD
Make changes to existing file or set of information.	ADAPT ADJUST ALTER CHANGE MODIFY	ADJUST
Accept nonstandard input.	ACCEPT ADMIT ENTER	ADMIT

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Append new information to an existing file or set of information.	ADD ADJOIN AFFIX APPEND ATTACH INCREASE INSERT	APPEND
Arrange a set of data in an alphabetical sequence.	ALPHABETIZE SEQUENCE SERIALIZE	ALPHABETIZE
Make rectangular arrangement of data into rows and columns.	ARRANGE ARRAY BLOCK	ARRAY
Set file space aside for special purpose.	ASSIGN DEDICATE	ASSIGN
Call up numeric data for examination.	AUDIT AUTHENTICATE EXAMINE VALIDATE VERIFY	AUDIT
Establish data or set of information as genuine.	AUTHENTICATE VALIDATE VERIFY	AUTHENTICATE
Calculate the arithmetic mean of a set of numeric data.	AVERAGE CALCULATE MEAN	AVERAGE
Form an expansion to a file or set of information separate from the main part.	ATTACH BRANCH EXPAND FORK	BRANCH

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Stop print. Discontinue print of file or set of information.	ABORT BREAK DISCONTINUE STOP	BREAK
Define an output format.	BUILD FORMAT	BUILD
Print schedule/calendar.	CALENDAR SCHEDULE	CALENDAR
Call up a function or processing routine.	CALL FETCH FILE FILE = FIND GET NAME	CALL
End (stop) all operations.	ABORT CEASE END HALT QUIT STOP	CEASE
Arrange a set of data in a historical sequence.	CALENDAR CHRONICLE SEQUENCE	CHRONICLE
Transform full language to coded information state.	CHANGE CODE TRANSFORM	CODE
Add color to a displayed output.	COLOR INTENSIFY RECOLOR	COLOR

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Integrate one file or set of information with another.	ASSIMILATE COMBINE INTEGRATE JOIN MERGE	COMBINE
Add remarks to a file or set of information.	ADD COMMENT REMARK	COMMENT
Condense a file or set of information.	ABRIDGE CONDENSE EXTRACT	CONDENSE
Activate a peripheral unit.	ACTIVATE ACTUATE CONNECT EXECUTE	CONNECT
Continue with current action.	CONTINUE	CONTINUE
Change data into another measurement form.	CHANGE CONVERT TRANSFORM	CONVERT
Copy a file or set of information.	CLONE COPY DISK DUP DUPLICATE RECORD D RECORD T REPEAT REWRITE TAPE	COPY
Determine the number of things in a series.	COUNT ENUMERATE NUMBER	COUNT

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Indicate date only of operation or event.	CALENDAR DATE DATE/TIME	DATE
Indicate date and time of operation or event.	CALENDAR DATE DATE/TIME	DATE/TIME
Transform coded information to full text.	CHANGE DECODE TRANSFORM	DECODE
Decrease a counter.	DECREASE SUBTRACT	DECREASE
Postpone processing indefinitely.	DEFER DELAY HALT HOLD PAUSE POSTPONE	DEFER
Delay for stated amount of time.	DEFER DELAY HALT HOLD PAUSE POSTPONE	DELAY
Delete an existing file or set of information.	ABORT CLEAR DELETE DESTROY KILL LOGOFF OMIT PURGE REMOVE UNSAVE ZAP	DELETE

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Set boundaries around a stated value.	BOUND DELIMIT LIMIT	DELIMIT
Display index of all available files of information.	DIRECTORY DISPLAY FILES INDEX LIST SHOW	DIRECTORY
Deny the validity/authenticity of data or set of information.	DENY DISAUTHENTICATE DISCLAIM	DISCLAIM
Sever the connection between a peripheral unit and the CPU.	DISCONNECT UNDO	DISCONNECT
Store a file or set of information on disk.	COPY DISK DOUT FILE FILEOUT HOLD HOLD D KEEP RECORD RECORD D RETAIN SAVE STORE WRITE WRITE TO DISK W 2 DK	DISK
Display a report or partial report on the screen.	DISPLAY SHOW	DISPLAY
Perform the mathematical operation of division.	DIVIDE SEPARATE	DIVIDE

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Edit a file or set of information.	CORRECT EDIT UPDATE	EDIT
Admit information into the system.	ADMIT ENTER	ENTER
Exchange one piece of information for another.	EXCHANGE MOVE SUBSTITUTE TRANSFER TRANSPOSE	EXCHANGE
Call up and use a specific procedure/program.	EXECUTE RUN START	EXECUTE
Extract portion from file or set of information.	ABRIDGE CONDENSE EXTRACT	EXTRACT
Screen out specified types of information from a file or set of information.	FILTER SCREEN SEPARATE SORT	FILTER
Find a designated portion of a file (i.e., data within a file).	FIND GET SEARCH SEEK	FIND
Define an input or output format.	BUILD FORM FORMAT INPUT OUTPUT REPORT WRITE	FORMAT

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Indicate a file or set of information to work with.	CONNECT DEFINE FETCH FILE FILE = FIND GET LOAD RECALL REQUEST SELECT USE	GET
Lend assistance.	HELP	HELP
Increment a counter.	ADD ADVANCE INCREASE INCREMENT	INCREASE
Display index of all files.	DIRECTORY DISPLAY FILES INDEX	INDEX
Request for indication of types of function needed.	CALL INQUIRY	INQUIRY
Insert new information in file or set of information.	ADD INSERT	INSERT
Intensify the existing color of a displayed output.	CHANGE COLOR INTENSIFY RECOLOR	INTENSIFY
Attach one file to the end of another file.	APPEND ATTACH JOIN	JOIN

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Leave the system.	ABORT BYE DONE END EXIT LOGOFF OFF QUIT SIGNOFF STOP	LOGOFF
Enter the system.	BEGIN ENTER ID IDENT LOGON SIGNON USER	LOGON
Merge data in a file or set of information.	ADJOIN ADMIT CONCATENATE CONNECT INSERT JOIN MERGE	MERGE
Modify a file or set of information to a certain specification.	ADAPT ADJUST ALTER CHANGE MODIFY	MODIFY
Move information within a file or set of information.	EXCHANGE MOVE TRANSFER TRANSPOSE	MOVE
Perform the mathematical operation of multiplication.	EXPAND MULTIPLY	MULTIPLY

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Create a new file or set of information.	CREATE FILE FILE = FILEOUT NEW NEWFILE	NEWFILE
Assign sequential numbers to things in a series.	COUNT ENUMERATE NUMBER	NUMBER
Exclude a piece of information from a report.	DELETE DESTROY OMIT REMOVE	OMIT
Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT OVERWRITE PRINT WRITE	OVERPRINT
Page forward.	CARRIAGE RETURN FORWARD NEXT PAGE PAGE AHEAD	PAGE AHEAD
Page backward.	BACK BACKWARD PAGE PAGE BACK PAGE BACKWARD PREVIOUS	PAGE BACK
Stop temporarily.	HALT PAUSE POSTPONE	PAUSE

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Print a hard copy.	COPY LIST LP = OUTPUT PRINT WRITE	PRINT
Protect a file or set of information.	PRESERVE PROTECT READ SAVE	PROTECT
Change the color of a displayed output.	CHANGE COLOR RECOLOR	RECOLOR
Request a reply from the CPU or another terminal.	ANSWER REPLY RESPOND	REPLY
Delete a piece of information from a file or set of information.	DELETE DESTROY OMIT REMOVE	REMOVE
Store a file or set of information.	RECORD SAVE STORE	SAVE
Screen out specified types of information to be assimilated in a file or set of information.	FILTER SCREEN SEPARATE SORT	SCREEN
Find designated file.	FIND GET SEARCH SEEK	SEARCH

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Select and activate a computer-controlled device.	ACTIVATE ACTUATE AFFIX ATTACH CONNECT EXECUTE GO SELECT	SELECT
Arrange data into two or more files or sets of information.	ARRANGE DIVIDE SEPARATE SORT	SEPARATE
Arrange a set of data in a causal-results sequence.	ARRANGE ARRAY SEQUENCE SERIALIZE	SEQUENCE
Arrange a set of data in a specified sequential order.	ARRANGE ENUMERATE NUMBER SEQUENCE SERIALIZE	SERIALIZE
Display the content of a field.	DISPLAY LIST SHOW TERMINAL TO = VIEW WRITE W 2 TO	SHOW
Sort data in a file or set of information.	ARRANGE ARRAY ASSORT ORDER SEQUENCE SORT	SORT

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Get system status.	GET STATUS SYSTAT	STATUS
Perform the mathematical operation of subtraction.	DELETE REDUCE SUBTRACT	SUBTRACT
Calculate the sum of a set of numbers.	ACCRETE ACCRUE ACCUMULATE ADD SUM	SUM
Notify user/operator at another terminal of a condition or event.	ADVISE APPRISE NOTIFY TELL	TELL
Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	SAVE TRANSCRIBE TRANSFER WRITE	TRANSCRIBE
Move information from one file to another.	EXCHANGE MOVE TRANSCRIBE TRANSFER TRANSPOSE	TRANSFER
Exchange the order (sequence) of two pieces of information within a file.	EXCHANGE MOVE TRANSFER TRANSPOSE	TRANSPOSE

Table 6.5-2. Cont'd

OPERATION	POTENTIAL COMMANDS	RECOMMENDED COMMAND
Prove as true by presenting other/detailed information.	AUTHENTICATE CONFIRM VALIDATE VERIFY	VALIDATE
Substantiate truth or authenticity by expertise.	AUTHENTICATE CONFIRM VALIDATE VERIFY	VERIFY
Wait for input.	DELAY HOLD WAIT	WAIT
Write a file or set of information on tape.	COPY HOLD T RECORD T SAVE TAPE TAPEOUT TOUT WRITE WRITE TO TAPE W 2 TP	WRITE

Table 6.5-3. Glossary of Commands Organized by Potential Commands

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ABORT	Discontinue current operation.	ABORT
	Stop print. Discontinue print of file or set of information.	BREAK
	End (stop) all operations.	CEASE
	Delete an existing file or set of information.	DELETE
	Leave the system.	LOGOFF
ABRIDGE	Discontinue current operation.	ABORT
	Condense a file or set of information.	CONDENSE
	Extract portion from file or set of information.	EXTRACT
ACCEPT	Accept nonstandard input.	ADMIT
ACCRETE	Accumulate a running total of incoming numeric data.	ACCRUE
	Accumulate a presented set of numeric values, summing to a total.	ADD
	Calculate the sum of a set of numbers.	SUM
ACCRUE	Accumulate a running total of incoming numeric data.	ACCRUE
	Accumulate a presented set of numeric values, summing to a total.	ADD
	Calculate the sum of a set of numbers.	SUM

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ACCUMULATE	Accumulate a running total of incoming numeric data.	ACCRUE
	Accumulate a presented set of numeric values, summing to a total.	ADD
	Calculate the sum of a set of numbers.	SUM
ACKNOWLEDGE	Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE
ACTIVATE	Activate a computer-controlled device.	ACTIVATE
	Activate a peripheral unit.	CONNECT
	Select and activate a computer-controlled device.	SELECT
ACTUATE	Activate a peripheral unit.	CONNECT
	Select and activate a computer-controlled device.	SELECT
ADAPT	Make changes to existing file or set of information.	ADJUST
	Modify a file or set of information to a certain specification.	MODIFY

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ADD	Accumulate a running total of incoming numeric data.	ACCRUE
	Accumulate a presented set of numeric values, summing to a total.	ADD
	Append new information to an existing file or set of information.	APPEND
	Add remarks to a file or set of information.	COMMENT
	Increment a counter.	INCREASE
	Insert new information in file or set of information.	INSERT
	Calculate the sum of a set of numbers.	SUM
ADJOIN	Append new information to an existing file or set of information.	APPEND
	Merge data in a file or set of information.	MERGE
ADJUST	Make changes to existing file or set of information.	ADJUST
	Modify a file or set of information to a certain specification.	MODIFY
ADMIT	Accept nonstandard input.	ADMIT
	Admit information into the system.	ENTER
	Merge data in a file or set of information.	MERGE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ADVANCE	Increment a counter.	INCREASE
ADVISE	Notify user/operator at another terminal of a condition or event.	TELL
AFFIX	Append new information to an existing file or set of information.	APPEND
	Select and activate a computer-controlled device.	SELECT
ALPHABETIZE	Arrange a set of data in an alphabetical sequence.	ALPHABETIZE
ALTER	Make changes to existing file or set of information.	ADJUST
	Modify a file or set of information to a certain specification.	MODIFY
ANSWER	Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE
	Request a reply from the CPU or another terminal.	REPLY
APPEND	Append new information to an existing file or set of information.	APPEND
	Attach one file to the end of another file.	JOIN

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
APPRISE	Notify user/operator at another terminal of a condition or event.	TELL
ARRANGE	Make rectangular arrangement of data into rows and columns.	ARRAY
	Arrange data into two or more files or sets of information.	SEPARATE
	Arrange a set of data in a causal-results sequence.	SEQUENCE
	Arrange a set of data in a specified sequential order.	SERIALIZE
	Sort data in a file or set of information.	SORT
ARRAY	Make rectangular arrangement of data into rows and columns.	ARRAY
	Arrange a set of data in a causal-results sequence.	SEQUENCE
	Sort data in a file or set of information.	SORT
ASSIGN	Set file space aside for special purpose.	ASSIGN
ASSIMILATE	Integrate one file or set of information with another.	COMBINE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ASSORT	Sort data in a file or set of information.	SORT
ATTACH	Append new information to an existing file or set of information.	APPEND
	Form an expansion to a file or set of information separate from the main part.	BRANCH
	Attach one file to the end of another file.	JOIN
	Select and activate a computer-controlled device.	SELECT
AUDIT	Call up numeric data for examination.	AUDIT
AUTHENTICATE	Call up numeric data for examination.	AUDIT
	Establish data or set of information as genuine.	AUTHENTICATE
	Prove as true by presenting other/detailed information.	VALIDATE
	Substantiate truth or authenticity by expertise.	VERIFY
AVERAGE	Calculate the arithmetic mean of a set of numeric data.	AVERAGE
BACK	Page backward.	PAGE BACK

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
BACKWARD	Page backward.	PAGE BACK
BEGIN	Enter the system.	LOGON
BLOCK	Make rectangular arrangement of data into rows and columns.	ARRAY
BOUND	Set boundaries around a stated value.	DELIMIT
BRANCH	Form an expansion to a file or set of information separate from the main part.	BRANCH
BREAK	Stop print. Discontinue print of file or set of information.	BREAK
BUILD	Define an output format.	BUILD
BYE	Leave the system.	LOGOFF
CALCULATE	Calculate the arithmetic mean of a set of numeric data.	AVERAGE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
CALENDAR	Print schedule/calendar.	CALENDAR
	Arrange a set of data in a historical sequence.	CHRONICLE
	Indicate date only of operation or event.	DATE
	Indicate date and time of operation or event.	DATE/TIME
CALL	Call up a function or processing routine.	CALL
	Request for indication of types of function needed.	INQUIRY
CARRIAGE RETURN	Page forward.	PAGE AHEAD
CEASE	Discontinue current operation.	ABORT
	End (stop) all operations.	CEASE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
CHANGE	Make changes to existing file or set of information.	ADJUST
	Accept nonstandard input.	ADMIT
	Transform full language to coded information state.	CODE
	Change data into another measurement form.	CONVERT
	Transform coded information to full text.	DECODE
	Modify a file or set of information to a certain specification.	MODIFY
	Intensify the existing color of a displayed output.	INTENSIFY
	Change the color of a displayed output.	RECOLOR
CHRONICLE	Arrange a set of data in a historical sequence.	CHRONICLE
CLEAR	Delete an existing file or set of information.	DELETE
CLONE	Copy a file or set of information.	COPY
CODE	Transform full language to coded information state.	CODE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
COLOR	Add color to a displayed output.	COLOR
	Intensify the existing color of a displayed output.	INTENSIFY
	Change the color of a displayed output.	RECOLOR
COMBINE	Integrate one file or set of information with another.	COMBINE
COMMENT	Add remarks to a file or set of information.	COMMENT
CONCATENATE	Merge data in a file or set of information.	MERGE
CONDENSE	Condense a file or set of information.	CONDENSE
	Extract a portion from a file or set of information.	EXTRACT
CONFIRM	Prove as true by presenting other/detailed information.	VALIDATE
	Substantiate truth or authenticity by expertise.	VERIFY

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
CONNECT	Activate a peripheral unit.	CONNECT
	Indicate a file or set of information to work with.	GET
	Merge data in a file or set of information.	MERGE
	Select and activate a computer-controlled device.	SELECT
CONTINUE	Continue with current action.	CONTINUE
CONVERT	Change data into another measurement form.	CONVERT
COPY	Copy a file or set of information.	COPY
	Store a file or set of information on disk.	DISK
	Print hard copy.	PRINT
	Write a file or set of information on tape.	WRITE
CORRECT	Edit a file or set of information.	EDIT
COUNT	Determine the number of things in a series.	COUNT
	Assign sequential numbers to things in a series.	NUMBER

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
CREATE	Create a new file or set of information.	NEWFILE
DATE	Indicate date only of operation or event.	DATE
	Indicate date and time of operation or event.	DATE/TIME
DATE/TIME	Indicate date only of operation or event.	DATE
	Indicate date and time of operation or event.	DATE/TIME
DECODE	Transform coded information to full text.	DECODE
DECREASE	Decrease a counter.	DECREASE
DEDICATE	Set file space aside for special purpose.	ASSIGN
DEFER	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
DEFINE	Indicate a file or set of information to work with.	GET

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
DELAY	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
	Wait for input.	WAIT
DELETE	Delete an existing file or set of information.	DELETE
	Exclude a piece of information from a report.	OMIT
	Delete a piece of information from a file or set of information.	REMOVE
	Perform the mathematical operation of subtraction.	SUBTRACT
DELIMIT	Set boundaries around a stated value.	DELIMIT
DENY	Deny the validity/authenticity of data or set of information.	DISCLAIM
DESTROY	Delete an existing file or set of information.	DELETE
	Exclude a piece of information from a report.	OMIT
	Delete a piece of information from a file or set of information.	REMOVE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
DIRECTORY	Display index of all available files of information.	DIRECTORY
	Display index of all files.	INDEX
DISAUTHENTICATE	Deny the validity/authenticity of data or set of information.	DISCLAIM
DISCLAIM	Deny the validity/authenticity of data or set of information.	DISCLAIM
DISCONNECT	Sever the connection between a peripheral unit and the CPU.	DISCONNECT
DISCONTINUE	Stop print. Discontinue print of file or set of information.	BREAK
DISK	Copy a file or set of information.	COPY
	Store a file or set of information on disk.	DISK
DISPLAY	Display index of all available files of information.	DIRECTORY
	Display a report or partial report on the screen.	DISPLAY
	Increment a counter.	INCREASE
	Display the content of a field.	SHOW

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
DIVIDE	Perform the mathematical operation of division.	DIVIDE
	Arrange data into two or more files or sets of information.	SEPARATE
DONE	Leave the system.	LOGOFF
DOUT	Store a file or set of information on disk.	DISK
DUP	Copy a file or set of information.	COPY
DUPLICATE	Copy a file or set of information.	COPY
EDIT	Edit a file or set of information.	EDIT
END	Discontinue current operation.	ABORT
	End (stop) all operations.	CEASE
	Leave the system.	LOGOFF
ENTER	Accept nonstandard input.	ADMIT
	Admit information into the system.	ENTER
	Enter the system.	LOGON

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
ENUMERATE	Determine the number of things in a series.	COUNT
	Assign sequential numbers to things in a series.	NUMBER
	Arrange a set of data in a specified sequential order.	SERIALIZE
EXAMINE	Call up numeric data for examination.	AUDIT
EXCHANGE	Exchange one piece of information for another.	EXCHANGE
	Move information within a file or set of information.	MOVE
	Move information from one file to another.	TRANSFER
	Exchange the order (sequence) of two pieces of information within a file.	TRANSPOSE
EXECUTE	Activate a computer-controlled device.	ACTIVATE
	Activate a peripheral unit.	CONNECT
	Call up and use a specific procedure/program.	EXECUTE
	Select and activate a computer-controlled device.	SELECT
EXIT	Leave the system.	LOGOFF

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
EXPAND	Form an expansion to a file or set of information separate from the main part.	BRANCH
	Perform the mathematical operation of multiplication.	MULTIPLY
EXTRACT	Condense a file or set of information.	CONDENSE
	Extract a portion from a file or a set of information.	EXTRACT
FETCH	Call up a function or processing routine.	CALL
	Indicate a file or set of information to work with.	GET
FILE	Call up a function or processing routine.	CALL
	Store a file or set of information on disk.	DISK
	Indicate a file or set of information to work with.	GET
	Create a new file or set of information.	NEWFILE
FILE =	Call up a function or processing routine.	CALL
	Indicate a file or set of information to work with.	GET
	Create a new file or set of information.	NEWFILE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
FILEOUT	Store a file or set of information on disk.	DISK
	Create a new file or set of information.	NEWFILE
FILES	Display index of all available files of information.	DIRECTORY
	Display index of all files.	INDEX
FILTER	Screen out specified types of information from a file or set of information.	FILTER
	Screen out specified types of information to be assimilated in a file or set of information.	SCREEN
FIND	Call up a function or processing routine.	CALL
	Find a designated portion of a file (i.e., data within a file).	FIND
	Indicate a file or set of information to work with.	GET
	Find designated file.	SEARCH
FORK	Form an expansion to a file or set of information separate from the main part.	BRANCH
FORM	Define an input or output format.	FORMAT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
FORMAT	Define an output format.	BUILD
	Define an input or output format.	FORMAT
FORWARD	Page forward.	PAGE AHEAD
GET	Call up a function or processing routine.	CALL
	Find a designated portion of a file (i.e., data within a file).	FIND
	Indicate a file or set of information to work with.	GET
	Find designated file.	SEARCH
	Get system status.	STATUS
GO	Activate a computer-controlled device.	ACTIVATE
	Select and activate a computer-controlled device.	SELECT
HALT	Discontinue current operation.	ABORT
	End (stop) all operations.	CEASE
	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
	Stop temporarily.	PAUSE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
HELP	Lend assistance.	HELP
HOLD	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
	Store a file or set of information on disk.	DISK
	Wait for input.	WAIT
HOLD D	Store a file or set of information on disk.	DISK
HOLD T	Write a file or set of information on tape.	WRITE
ID	Enter the system.	LOGON
IDENT	Enter the system.	LOGON
INCREASE	Append new information to an existing file or set of information.	APPEND
	Increment a counter.	INCREASE
INCREMENT	Increment a counter.	INCREASE
INDEX	Display index of all available files of information.	DIRECTORY
	Display index of all files.	INDEX

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
INPUT	Define an input or output format.	FORMAT
INQUIRY	Request for indication of types of function needed.	INQUIRY
INSERT	Append new information to an existing file or set of information.	APPEND
	Merge data in a file or set of information.	MERGE
	Insert new information in file or set of information.	INSERT
INTEGRATE	Integrate one file or set of information with another.	COMBINE
INTENSIFY	Add color to a displayed output.	COLOR
	Intensify the existing color of a displayed output.	INTENSIFY
JOIN	Integrate one file or set of information with another.	COMBINE
	Merge data in a file or set of information.	MERGE
	Attach one file to tne end of another file.	JOIN
KEEP	Store a file or set of information on disk.	DISK

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
KILL	Delete an existing file or set of information.	DELETE
LIMIT	Set boundaries around a stated value.	DELIMIT
LIST	Display index of all available files of information.	DIRECTORY
	Print a hard copy.	PRINT
	Display the content of a field.	SHOW
LOAD	Indicate a file or set of information to work with.	GET
LOGOFF	Delete an existing file or set of information.	DELETE
	Leave the system.	LOGOFF
LOGON	Enter the system.	LOGON
LP =	Print a hard copy.	PRINT
MEAN	Calculate the arithmetic mean of a set of numeric data.	AVERAGE
MERGE	Integrate one file or set of information with another.	COMBINE
	Merge data in a file or set of information.	MERGE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
MESSAGE	Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE
MODIFY	Make changes to existing file or set of information.	ADJUST
	Modify a file or set of information to a certain specification.	MODIFY
MOVE	Exchange one piece of information for another.	EXCHANGE
	Move information within a file or set of information.	MOVE
	Move information from one file to another.	TRANSFER
	Exchange the order (sequence) of two pieces of information within a file.	TRANSPOSE
MULTIPLY	Perform the mathematical operation of multiplication.	MULTIPLY
NAME	Call up a function or processing routine.	CALL
NEW	Create a new file or set of information.	NEWFILE
NEWFILE	Create a new file or set of information.	NEWFILE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
NEXT	Page forward.	PAGE AHEAD
NOTIFY	Notify user/operator at another terminal of a condition or event.	TELL
NUMBER	Determine the number of things in a series.	COUNT
	Assign sequential numbers to things in a series.	NUMBER
	Arrange a set of data in a specified sequential order.	SERIALIZE
OFF	Leave the system.	LOGOFF
OMIT	Delete an existing file or set of information.	DELETE
	Exclude a piece of information from a report	OMIT
	Delete a piece of information from a file or set of information.	REMOVE
ORDER	Sort data in a file or set of information.	SORT
OVERPRINT	Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
OUTPUT	Define an input or output format.	FORMAT
	Print a hard copy.	PRINT
OVERWRITE	Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT
PAGE	Page forward.	PAGE AHEAD
	Page backward.	PAGE BACK
PAGE AHEAD	Page forward.	PAGE AHEAD
PAGE BACK	Page backward.	PAGE BACK
PAGE BACKWARD	Page backward.	PAGE BACK
PAUSE	Discontinue current operation.	ABORT
	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
	Stop temporarily.	PAUSE
POSTPONE	Postpone processing indefinitely.	DEFER
	Delay for stated amount of time.	DELAY
	Stop temporarily.	PAUSE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
PRESERVE	Protect a file or set of information.	PROTECT
PREVIOUS	Page backward.	PAGE BACK
PRINT	Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT
	Print a hard copy.	PRINT
PROTECT	Protect a file or set of information.	PROTECT
PURGE	Delete an existing file or set of information.	DELETE
QUIT	Discontinue current operation.	ABORT
	End (stop) all operations.	CEASE
	Leave the system.	LOGOFF
READ	Protect a file or set of information.	PROTECT
RECALL	Indicate a file or set of information to work with.	GET

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
RECOLOR	Add color to a displayed output.	COLOR
	Intensify the existing color of a displayed output.	INTENSIFY
	Change the color of a displayed output.	RECOLOR
RECORD	Store a file or set of information on disk.	DISK
	Store a file or set of information.	SAVE
RECORD D	Copy a file or set of information.	COPY
	Store a file or set of information on disk.	DISK
RECORD T	Copy a file or set of information.	COPY
	Write a file or set of information on tape.	WRITE
REDUCE	Perform the mathematical operation of subtraction.	SUBTRACT
REMARK	Add remarks to a file or set of information.	COMMENT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
REMOVE	Delete an existing file or set of information.	DELETE
	Exclude a piece of information from a report.	OMIT
	Delete a piece of information from a file or set of information.	REMOVE
REPEAT	Copy a file or set of information.	COPY
REPLY	Acknowledge a message from the CPU or another terminal.	ACKNOWLEDGE
	Request a reply from the CPU or another terminal.	REPLY
REPORT	Define an input or output format.	FORMAT
REQUEST	Indicate a file or set of information to work with.	GET
RESPOND	Request a reply from the CPU or another terminal.	REPLY
RETAIN	Store a file or set of information on disk.	DISK
REWRITE	Copy a file or set of information.	COPY

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
RUN	Call up and use a specific procedure/program.	EXECUTE
SAVE	Store a file or set of information on disk.	DISK
	Protect a file or set of information.	PROTECT
	Store a file or set of information.	SAVE
	Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	TRANSCRIBE
	Write a file or set of information on tape.	WRITE
SCHEDULE	Print schedule/calendar.	CALENDAR
SCREEN	Screen out specified types of information from a file or set of information.	FILTER
	Screen out specified types of information to be assimilated in a file or set of information.	SCREEN
SEARCH	Find a designated portion of a file (i.e., data within a file).	FIND
	Find designated file.	SEARCH

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
SEEK	Find a designated portion of a file (i.e., data within a file).	FIND
	Find designated file.	SEARCH
SELECT	Indicate a file or set of information to work with.	GET
	Select and activate a computer-controlled device.	SELECT
SEPARATE	Perform the mathematical operation of division.	DIVIDE
	Screen out specified types of information from a file or set of information.	FILTER
	Screen out specified types of information to be assimilated in a file or set of information.	SCREEN
	Arrange data into two or more files or sets of information.	SEPARATE
SEQUENCE	Arrange a set of data in an alphabetical sequence.	ALPHABETIZE
	Arrange a set of data in a historical sequence.	CHRONICLE
	Arrange a set of data in a causal-results sequence.	SEQUENCE
	Arrange a set of data in a specified sequential order.	SERIALIZE
	Sort data in a file or set of information.	SORT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
SERIALIZE	Arrange a set of data in an alphabetical sequence.	ALPHABETIZE
	Arrange a set of data in a causal-results sequence.	SEQUENCE
	Arrange a set of data in a specified sequential order.	SERIALIZE
SHOW	Display index of all available files of information.	DIRECTORY
	Display a report or partial report on the screen.	DISPLAY
	Display the content of a field.	SHOW
SIGNOFF	Leave the system.	LOGOFF
SIGNON	Enter the system.	LOGON
SORT	Screen out specified types of information from a file or set of information.	FILTER
	Screen out specified types of information to be assimilated in a file or set of information.	SCREEN
	Arrange data into two or more files or sets of information.	SEPARATE
	Sort data in a file or set of information.	SORT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
START	Activate a computer-controlled device.	ACTIVATE
	Call up and use a specific procedure/program.	EXECUTE
STATUS	Get system status.	STATUS
STOP	Discontinue current operation.	ABORT
	Stop print. Discontinue print of file or set of information.	BREAK
	End (stop) all operations.	CEASE
	Leave the system.	LOGOFF
STORE	Store a file or set of information on disk.	DISK
	Store a file or set of information.	SAVE
SUBSTITUTE	Exchange one piece of information for another.	EXCHANGE
SUBTRACT	Decrease a counter.	DECREASE
	Perform the mathematical operation of subtraction.	SUBTRACT

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
SUM	Accumulate a running total of incoming numeric data.	ACCRUE
	Accumulate a presented set of numeric values, summing to a total.	ADD
	Calculate the sum of a set numbers.	SUM
SYSTAT	Get system status.	STATUS
TAPE	Copy a file or set of information.	COPY
	Write a file or set of information on tape.	WRITE
TAPEOUT	Write a file or set of information on tape.	WRITE
TELL	Notify user/operator at another terminal of a condition or event.	TELL
TERMINAL	Display the content of a field.	SHOW
TO =	Display the content of a field.	SHOW
TOUT	Write a file or set of information on tape.	WRITE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
TRANSCRIBE	Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	TRANSCRIBE
	Move information from one file to another.	TRANSFER
TRANSFER	Exchange one piece of information for another.	EXCHANGE
	Move information within a file or set of information.	MOVE
	Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	TRANSCRIBE
	Move information from one file to another.	TRANSFER
	Exchange the order (sequence) of two pieces of information within a file.	TRANSPOSE
TRANSFORM	Transform full language to coded information state.	CODE
	Change data into another measurement form.	CONVERT
	Transform coded information to full text.	DECODE

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
TRANSPOSE	Exchange one piece of information for another.	EXCHANGE
	Move information within a file or set of information.	MOVE
	Move information from one file to another.	TRANSFER
	Exchange the order (sequence) of two pieces of information within a file.	TRANSPOSE
UNDO	Sever the connection between a peripheral unit and the CPU.	DISCONNECT
UNSAVE	Delete an existing file or set of information.	DELETE
UPDATE	Edit a file or set of information.	EDIT
USE	Indicate a file or set of information to work with.	GET
USER	Enter the system.	LOGON
VALIDATE	Call up numeric data for examination.	AUDIT
	Establish data or set of information as genuine.	AUTHENTICATE
	Prove as true by presenting other/detailed information.	VALIDATE
	Substantiate truth or authenticity by expertise.	VERIFY

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
VERIFY	Call up numeric data for examination.	AUDIT
	Establish data or set of information as genuine.	AUTHENTICATE
	Prove as true by presenting other/detailed information.	VALIDATE
	Substantiate truth or authenticity by expertise.	VERIFY
VIEW	Display the content of a field.	SHOW
WAIT	Wait for input.	WAIT
WRITE	Store a file or set of information on disk.	DISK
	Define an input or output format.	FORMAT
	Enter data within an input or output format so as to erase and replace existing information.	OVERPRINT
	Print a hard copy.	PRINT
	Copy a file or set of information from one storage type to another (e.g., tape to disk, disk to tape).	TRANSCRIBE
	Write a file or set of information on tape.	WRITE
	Display the content of a field.	SHOW
WRITE TO DISK	Store a file or set of information on disk.	DISK

Table 6.5-3. Cont'd

POTENTIAL COMMAND	OPERATION	RECOMMENDED COMMAND
WRITE TO TAPE	Write a file or set of information on tape.	WRITE
W 2 DK	Store a file or set of information on disk.	DISK
W 2 TO	Display the content of a field.	SHOW
W 2 TP	Write a file or set of information on tape.	WRITE
ZAP	Delete an existing file or set of information.	DELETE

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SECTION 7. ERROR HANDLING

This section explores the methods and results of designing the human-computer interface to minimize the occurrence and impact of error by and through the user/operator. Techniques for minimizing the error recovery time and process complexity are presented. The guidelines encompass the following topics:

1. Error Feedback--deals with techniques for informing the user/operator that an error has been detected by the system.

2. Error Correction and Recovery--provides methods by which the user/operator can remove/correct an error with minimum system downtime or hesitation.

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7.1 Error Feedback

7.1.1 DEFINITION

Error feedback consists of messages from the system software to the user/operator which indicate that an error has occurred. This subsection deals with the ways that the system can provide error feedback to help the user/operator understand the nature and cause of the error.

7.1.2 APPLICATIONS FOR ERROR FEEDBACK

Error feedback is required any time the system detects an error. Applications for error feedback include:

a. Notification of illegal entry. Illegal entries are those entries in which the user's/operator's input does not match any of the items in a list of legal entries for the data field, or is outside the range of permissible numeric values.

EXAMPLE: An artillery command and control system permits the following entries for type of shell: ARMOR PIERCING, BIOLOGICAL, ILLUMINATION (FLARE), FRAGMENTATION, GAS/CHEMICAL, INCENDIARY, NUCLEAR, and SMOKE. The full name may be entered, or the following abbreviations may be used: ARM, BIO, ILL, FRA, GAS, INC, NUC, and SMO, respectively. These are the only entries for shell type recognized by the system. Thus, an entry of "FRG" for FRAGMENTATION, for example, would be treated as an illegal entry.

EXAMPLE: An armor division's command and control support system accepts any numerical value between 0 and 216, inclusive, for the number of tasks on tanks on hand. An entry of 234 would therefore be treated as an illegal entry.

b. Notification of omitted data. Omissions of required data occur when the user/operator neglects to enter data into a mandatory field or subfield.

EXAMPLE: In a command and control system, certain messages have a field for a date-time group specifying the data and time that the message's contents will become effective. Failure to enter data in this field is an omission error.

c. Notification of insertion of extraneous data. Insertion of an extraneous parameter occurs when a user/operator enters data in a field, or parameters in a command, in addition to the data/parameters that are required.

EXAMPLE: In a personnel accounting system, only the last four digits of the soldier's SSN are required to retrieve that soldier's data. If the user/operator enters the soldier's name as well as the last four digits in response to the prompt for the last four digits, the system treats the entry as an insertion error.

d. Notification of field length violation. Field length errors occur when the user/operator either enters too few characters or too many characters in a data field.

EXAMPLE: In the personnel accounting system mentioned under "c" above, entering the entire SSN would constitute a field length error.

EXAMPLE: In the artillery command and control system mentioned under "a" above, entering "A" instead of "ARM" to designate ARMOR PIERCING shells would constitute a field length error.

e. Notification of incorrect sequence of data entry. Incorrect sequence errors occur when the user/operator enters the correct number of data elements for a data field, or the correct number of command parameters, and each individual element or parameter is correct, but their order is incorrect.

EXAMPLE: In an intelligence information processing systems, most commands require multiple parameters in a specified order. For example, to print the first 50 records in a data file named WRNG.DAT, using a predefined format named "3," the user/operator must enter:

```
GET FILE WRNG.DAT, LIST, FMT3, S1, E50
```

Any other order of parameters is treated as an illegal sequence error. For example, the following is an illegal sequence error:

```
GET FILE WRNG.DAT, FMT3, LIST, S1, E50
```

f. Notification of contingency violation. Contingency violations occur in situations where entering data in one optional field causes a requirement for a subsequent entry in another field. The contingency error occurs when the user/operator enters data in the first field but not in the second field.

EXAMPLE: In a tactical command and control system, entering data about individual weapon systems is optional. However, if the user/operator enters data in the "WEAPON SYSTEM" field (e.g., M60A1), then the number of weapons on hand must also be entered. If neither "WEAPON SYSTEM" nor "ON HAND" is entered, then no error exists. If, on the other hand, the user/operator enters data in the "WEAPON SYSTEM" field but does not enter data in the "ON HAND" field, the system encounters a contingency violation.

g. Notification of association violation. Association violations occur when the user/operator enters two separate data items which, taken together, don't make sense. This error also occurs when the user/operator enters a single data item which, when associated with a previously stored item, doesn't make sense.

EXAMPLE: In associating a "mover" and a "shooter" in an intelligence information processing system, the user/operator enters "152mm" in the "SHOOTER" field and "PT76" in the "MOVER" field. Since the "PT76 is equipped with a 76mm gun, the two data entries are logically conflicting.

EXAMPLE: An intelligence information processing system uses a graphics display to show the locations of terrain and cultural features, and other relevant data. Users/operators add symbols to the display by placing a graphics cursor at the appropriate location on the screen and then choosing the appropriate symbol. The system then checks the symbol and location for likelihood. For example, if the user/operator placed a command post within the area of a lake, the system would treat this attempt as an illegal entry.

7.1.3 BENEFITS OF ERROR FEEDBACK

Benefits obtained by providing well-designed error feedback include:

a. Reducing error rates, by minimizing:

   1. The number of times a user/operator will unknowingly repeat an error if feedback is not provided.

   2. The number of times a user/operator will repeat an error while trying to make corrections on the basis of inadequate feedback.

   3. The user's/operator's frequency of error commission due to learning to avoid errors on the basis of informative feedback when errors occur.

b. Increasing system throughput rates, by minimizing:

   1. The time required for users/operators to look up error codes in off-line manuals.

   2. The time required for users/operators to understand the nature and cause of errors.

   3. The time required for users/operators to determine what action to take to correct errors.

c. Reducing training requirements, as affected by:

   1. Reduced need to train users/operators in associating error codes with error conditions.

   2. Reduced need to train users/operators in error diagnostic procedures.

7.1.4 METHODS FOR ERROR FEEDBACK

Basically, one method is appropriate for virtually all error feedback situations, though its implementation differs from one application to another. The method consists of:

a. An alarm to notify the user/operator that an error has occurred.

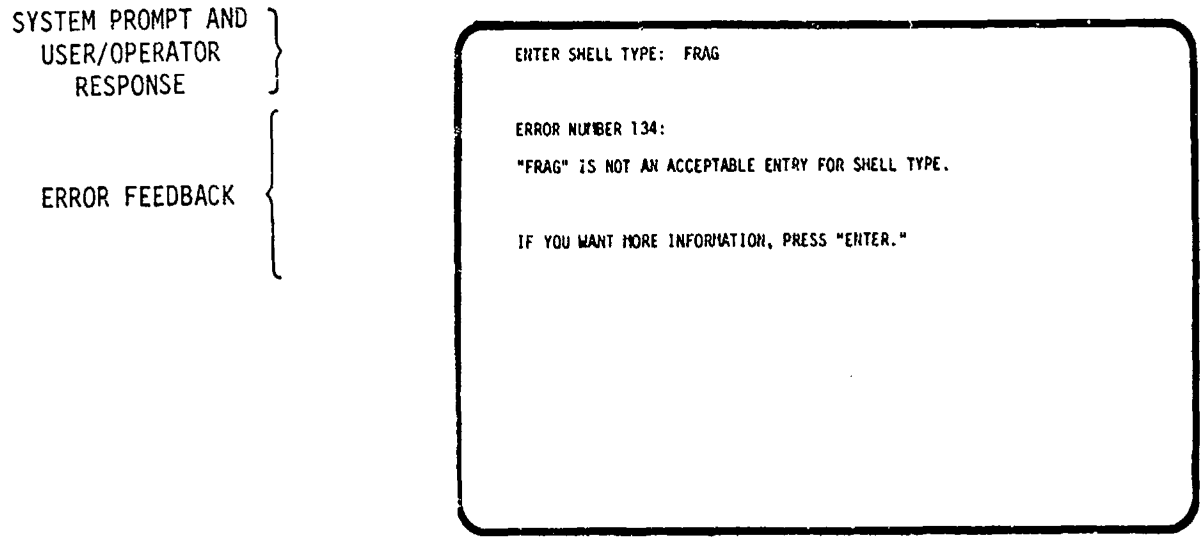
b. An error code number referring to off-line documentation.

c. An option to obtain a more detailed explanation of the error.

e. A detailed description of the error.

Examples of implementations of this method for each application described in Section 7.1.2 are provided below.

a. Illegal entries. In the hypothetical artillery command and control system used to illustrate illegal entries in Section 7.1.2, the only legal entries for shell type consisted of three-character abbreviations or the full name of the shell type. If the user/operator entered, say, "FRAG" instead of "FRA" or "FRAGMENTATION", the system would respond with an audible "beep" and the following display:



If the user/operator now remembers what constitutes a legal entry for shell types, the system allows another attempt to make a legal entry. On the other hand, if the user/operator has forgotten why "FRAG" is not a legal entry, then pressing the ENTER key produces the following display:

```
SHELL TYPE CAN BE ENTERED IN EITHER OF THE FOLLOWING WAYS:
    1.  A 3-LETTER ABBREVIATION
    2.  THE FULL NAME OF THE SHELL TYPE


"FRAG" IS NOT A 3-LETTER ABBREVIATION.
"FRAG" IS NOT A FULL NAME.


IF YOU WANT TO SEE THE LEGAL ENTRIES FOR SHELL TYPE, PRESS "ENTER."
```

Once again, the user/operator is permitted to attempt a legal entry, if desired. Or, if still unsure what constitutes a legal entry, the user/operator can press the ENTER key to see a list of the available legal entries.

b. Omitted data. In the hypothetical command and control system illustrating omitted entries in Section 7.1.2, certain messages required that the user/operator specify the date-time group when the message would become effective. Failure to enter data in that field would result in the following display:

```
ERROR NUMBER E29:
NO ENTRY MADE IN EFF-DTG FIELD


IF YOU WANT MORE INFORMATION, PRESS "ENTER."
```

If the user/operator presses the ENTER key, the system provides a more detailed explanation:

```
THE EFF-DTG TELLS THE SYSTEM WHEN YOUR MESSAGE WILL BECOME EFFECTIVE.
THIS FIELD REQUIRES AN ENTRY SO THAT INFORMATION IN THE MESSAGE CAN
BE USED AT THE PROPER TIME.  YOU DIDN'T ENTER A DATE-TIME GROUP, SO
THE SYSTEM DOESN'T KNOW WHEN THIS MESSAGE WILL BECOME EFFECTIVE.
```

c. Extraneous data. In the hypothetical personnel accounting system illustrating extraneous parameter errors in Section 7.1.2, the user/operator might enter "JONES, 5555" in response to a request for the last four digits of the serial number. The system's prompt, the user's/operator's response, and the system's error feedback might appear as follows:

```
LAST-FOUR-SSN:  JONES,5555

ERROR NUMBER S37:
"JONES,5555" CONTAINS TOO MANY PARAMETERS FOR THE LAST-FOUR-SSN FIELD.

IF YOU WANT MORE INFORMATION, PRESS "ENTER."
```

A request for more information would produce the following display:

```
THE LAST-FOUR-SSN FIELD CONTAINS THE LAST FOUR DIGITS OF A SOLDIER'S
SOCIAL SECURITY NUMBER.  NO OTHER INFORMATION IS REQUIRED IN THIS
FIELD.

"JONES,5555" CONTAINS DATA IN ADDITION TO THE LAST FOUR DIGITS OF A
SOLDIER'S SOCIAL SECURITY NUMBER.
```

d. Field length violation. In the hypothetical artillery command and control system used to illustrate illegal entries in Section 7.1.2, the user/operator must enter either a three-character abbreviation or a full name to specify shell type. Thus, entry of a single character would constitute a field length error. The system's initial response might be as shown below:

```
ENTER SHELL TYPE:  A

ERROR NUMBER 227:
SHELL TYPE REQUIRES AT LEAST 3 LETTERS

IF YOU WANT TO SEE LEGAL ENTRIES FOR SHELL TYPE, PRESS "ENTER."
```

If the user/operator understands the error and believes the required corrective action is apparent, a second attempt to enter shell type can be made. Otherwise, pressing the ENTER key produces the following display:

```
SHELL TYPE CAN BE ENTERED IN EITHER OF THE FOLLOWING WAYS:

    1. A 3-LETTER ABBREVIATION

    2. THE FULL NAME OF THE SHELL TYPE


"A" DOES NOT HAVE ENOUGH CHARACTERS TO BE AN ACCEPTABLE ABBREVIATION
OR TO BE THE FULL NAME OF A SHELL TYPE.


IF YOU WANT TO SEE THE LEGAL ENTRIES FOR SHELL TYPE, PRESS "ENTER."
```

e. Incorrect sequence of data entry. In the hypothetical intelligence information processing system that illustrated incorrect sequence errors in Section 7.1.2, the user/operator was required to enter command parameters in a particular sequence. For example, to print the first 50 records in a data file named "WRGN.DAT," using a predefined format name "3", the required command would be:

GET FILE WRNG.DAT, LIST, FMT3, S1, E50

The following display illustrates an incorrectly sequenced entry by the user/operator, and the system's response:

```
GET FILE WRNG.DAT, FMT3, LIST, S1, E50


ERROR C21:

PARAMETERS NOT IN CORRECT ORDER IN THE ABOVE COMMAND.


IF YOU WANT MORE INFORMATION, PRESS "ENTER."
```

A request for additional information would produce the following display:

```
THE GET FILE COMMAND REQUIRES THE FOLLOWING PARAMETERS:

    1. FILE NAME

    2. OPERATION
       A. SHOW (TO DISPLAY DATA RECORDS ON THE CRT SCREEN)
       B. LIST (TO PRINT DATA RECORDS ON THE PRINTER)

    3. FORMAT NAME

    4. START (FIRST RECORD TO BE RETRIEVED)

    5. END (LAST RECORD TO BE RETRIEVED)


THE FORM OF THE GET FILE COMMAND IS:

GET FILE (FILE NAME), (SHOW OR LIST), (FMTXX), (SXXX), (EXXX)


PARAMETERS MUST BE ENTERED IN THE ORDER SHOWN.
```

f. Contingency violation. In the hypothetical command and control system used to illustrate contingency violations in Section 7.1.2, entering data in the "WEAPON SYSTEM" and "ON HAND" fields is optional. However, if an entry is made in the "WEAPON SYSTEM" field, then an entry is mandatory in the "ON HAND" field. If the user/operator entered, say, "M60A1" in the "WEAPON SYSTEM" field but made no entry in the "ON HAND" field, then the system might respond as follows:

```
ERROR NUMBER L71:

"M60A1" ENTERED IN WEAPON SYSTEM FIELD BUT NO ENTRY MADE IN ON HAND
FIELD.


IF YOU WANT MORE INFORMATION, PRESS "ENTER."
```

If the user/operator recognizes the error, pressing RESTORE will restore the original message display, with previous entries intact and the cursor positioned to the first entry position of the "ON HAND" field. On the other hand, pressing ENTER will produce the following display:

```
THE WEAPON SYSTEM FIELD IS OPTIONAL; YOU DO NOT HAVE TO ENTER ANY
DATA IN THE FIELD.  HOWEVER, IF YOU ENTER ANYTHING IN THE WEAPON
SYSTEM FIELD, THEN YOU MUST ALSO ENTER DATA IN THE ON HAND FIELD.

YOU ENTERED "M60A1" IN THE WEAPON SYSTEM FIELD, BUT YOU DID NOT
ENTER THE NUMBER OF M60A1'S ON HAND IN THE ON HAND FIELD.
```

g. <u>Association violation</u>. In the hypothetical intelligence information processing system that illustrated association violations in Section 7.1.2, placing a command post symbol in a lake was interpreted as an error. The system's initial response to this entry might be:

```
ERROR NUMBER 369:
COMMAND POST SYMBOL PLACED IN LAKE.

IF YOU WANT MORE INFORMATION, PRESS "ENTER."
```

Pressing the ENTER key might produce:

```
CERTAIN KINDS OF ENTRIES MAY BE LEGAL WHEN YOU LOOK AT THEM ALONE.
BUT WHEN YOU COMPARE THEM WITH RELATED ENTRIES, THEY DO NOT MAKE
SENSE.  THAT SEEMS TO BE WHAT HAPPENED HERE.

"COMMAND POST" IS A LEGAL ENTRY IN THE ENTITY FIELD.

THE COORDINATES YOU ENTERED IN THE LOCATION FIELD ARE LEGAL VALUES.
HOWEVER, THE COORDINATES YOU ENTERED ARE IN A LAKE, AND PLACING A
COMMAND POST IN A LAKE DOES NOT MAKE SENSE.
```

7.1.5 RECOMMENDATIONS FOR ERROR FEEDBACK

a. Do not require the user/operator to translate error feedback messages.

b. Do not use computer jargon (e.g., "SYNTAX ERROR," "OUT OF RANGE ERROR") in error messages. Instead, explain what error condition exists. (See examples in Section 7.1.4.)

c. Always repeat the user's/operator's entry and the data field label in error message (e.g., "FRAG IS NOT AN ACCEPTABLE ENTRY FOR SHELL TYPE").

d. Allow the user/operator to control the amount of detail in error messages, progressing from brief messages to more extensive explanations at the user's/operator's option.

e. Do not present error numbers or codes alone; provide at least a brief explanation of the error along with the number or code.

f. Provide off-line documentation of all error messages keyed to the error number or code; but do not force the user/operator to consult off-line documentation to diagnose errors. Use off-line documentation to provide additional information, not as a "translator" for obscure feedback.

g. If system functions involve support to subjective decision making, prompt the user/operator to consider information that has been overlooked.

h. When the system detects missing data, prompt the user/operator to enter the required data rather than use default data.

i. Provide error feedback as soon as possible after the error occurs.

j. Do not assign blame, use patronizing language, or attempt to be humorous in error messages. Phrase error messages politely.

k. Present error information in a consistent location on the display device.

7.2 Error Correction and Recovery

7.2.1 DEFINITION

Error correction and recovery deals with the process and techniques used to correct errors and/or results of the system attempting to process erroneous data. The errors may be due to faulty user/operator technique or the correct entry of faulty information. Error correction and recovery includes resumption of terminal operation after a short processing halt, as well as recovery from system outage due to a software "crash."

7.2.2 APPLICATIONS FOR ERROR CORRECTION AND RECOVERY

The error correction/recovery task is the final step in the error detection/feedback/correction process. Whereas error detection and feedback involve the machine side of the software interface, error correction requires reaction from the user/operator. The user/operator takes steps in response to the error notation and message provided through the error feedback process. Applications for the error correction/recovery procedure are to correct the errors and error conditions identified by error detection. In brief, these are:

a. Entry of special codes, passwords, and identifications by the user/operator.

b. Entry of information through keyboard, voice, or other direct means by the user/operator.

c. Processing of information involving stored or file data and producing a usable output.

7.2.3 BENEFITS OF ERROR CORRECTION AND RECOVERY

Benefits associated with well designed error correction and recovery procedures include:

a. Reduced error rates, by minimizing:

   1. The number of attempts required by the user/operator to correct errors.

   2. The number of attempts/steps taken by the user/operator to complete the task.

b. Increased system throughput rates, by minimizing:

   1. The time required to correct an error.

   2. The time required to repeat processing.

   3. The time required for accessing system references.

c. Improved training of users/operators, as affected by:

   1. Reduction in the complexity of error correction instructions.

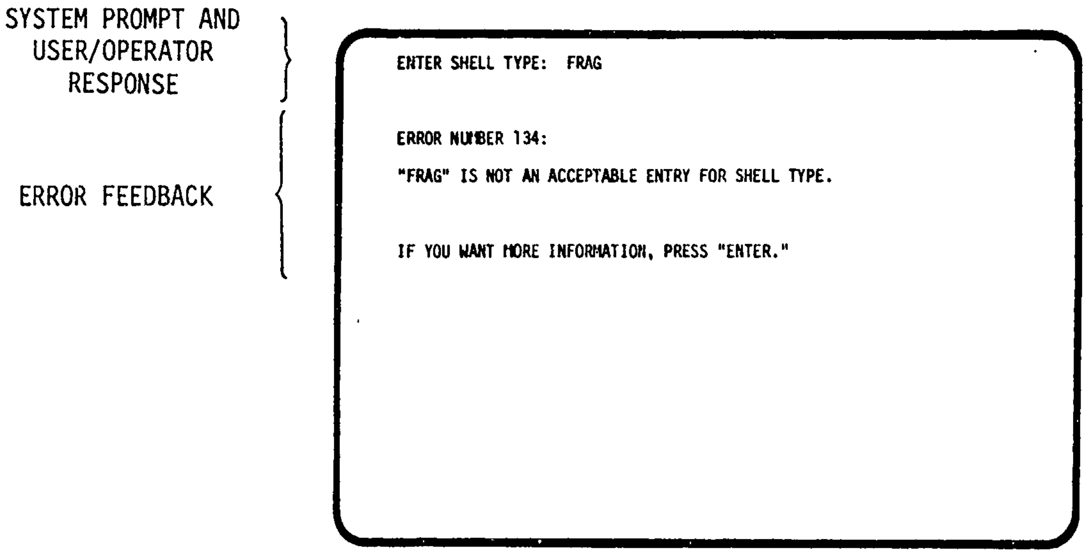
   2. Reduction in the time to instruct versus on-the-job experience.

7.2.4 METHODS FOR ERROR CORRECTION AND RECOVERY

Methods for error correction and recovery are affected by the error feedback capability of the system. The error correction task is strongly influenced by the message and options provided by error feedback. The assumption made for the source of error feedback information (a CRT, VDU, or hardcopy device) is continued for error correction. Tutorial advice can be called up by the user/operator by responding to a prompt to press "ENTER."

a. Data field(s) re-entry. This is the simplest and the most frequently used method for error correction. In this method, the system has detected the error, informed the user/operator, cleared the erroneous data field, backspaced, and awaits the user's/operator's next attempt. The user/operator enters the correct value in the data field using the error message and knowledge of the system. No external or system-supplied data are necessary.

EXAMPLE:



b. Data field(s) re-entry with system-generated assists (HELPs). This method of error correction and recovery starts with the error feedback message and the user's/operator's response to it. This method, however, is more complex in that it does not rely entirely on the error message, example, or user/operator skill. In this method, the user/operator has the option of calling on system-generated assists. This method takes longer than straight data re-entry due to the extra step, but offers the advantage of an on-line reference,

reduced training complexity, and reduced demand on user/operator memory.

EXAMPLE:

```
SHELL TYPE CAN BE ENTERED IN EITHER OF THE FOLLOWING WAYS:
    1. A 3-LETTER ABBREVIATION
    2. THE FULL NAME OF THE SHELL TYPE

"FRAG" IS NOT A 3-LETTER ABBREVIATION.
"FRAG" IS NOT A FULL NAME.

IF YOU WANT TO SEE THE LEGAL ENTRIES FOR SHELL TYPE, PRESS "ENTER."
```

c. <u>System or user/operator search and evaluation</u>. This type of error correction method may require the user/operator to perform a number of system queries to determine the source of the error. Real time system updates may have changed time-sensitive data in a file used by the user/operator in requesting an output from the system. Or, the user/operator may have requested an output that could not be provided due to an assumption error on the part of the user/operator, or an error may be present either in the logic of the request or in the existing stored data. The user/operator may be required to perform a search and evaluation in order to correctly process the request.

EXAMPLE:

```
ARTILLERY BARRAGE CANNOT BE SCHEDULED AS REQUESTED

FRIENDLY FORCES NOW IN CLOSE CONTACT TO IMPACT COORDINATES:
            23 x 14 x 2N - 114 x 29 x 16W
SELECTED FOR 1710H
```

This error message was received by the user/operator while attempting to schedule an artillery barrage on given coordinates at the time of the 1710H.

The user/operator must now access the history file to determine if friendly troops are near the coordinates, what unit they belong to, and how to contact them for verification. If the troops are in too close proximity to the impact area, the mission will have to be cancelled or rescheduled.

Using the information "friendly forces" and "23 x 14 x 2N - 114 x 29 x 16W," user/operator accesses the history file to find:

```
COMPANY B, BATTALION 1-45
LOCATION 23 x 14 x 2N x 114 x 29 x 11W"
TIME:  23/03/82 - 1400H
```

The information verifies the conflict, but the information is more than 3 hours old. The history file data expires after 2 hours, but no new update has been supplied as is required. In fact, Company B is now south of their old position and well out of range. The user/operator cannot override the history file and will have to contact the responsible authority for either a redate of the history file or an override.

7.2.5 RECOMMENDATIONS FOR ERROR CORRECTION AND RECOVERY

a. Table 7.2-1, Error Correction and Recovery Methods by Applications, presents a general list of recommendations for selecting the most effective error correction method or methods given the type of error. To use the table, first decide what error type applies to the situation you are considering. Eliminate any error correction method where a "4" appears as an entry. Select the best error correction method by comparing the remaining error types in view of the specific error type with which you are dealing.

7.2-1. Error Correction and Recovery Methods by Application

KEY: 1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

		APPLICATION, BY TYPE OF ERROR		
		SYNTAX	LOGIC	VALIDTY
METHOD	DATA FIELD(S) RE-ENTRY	1*	1	3
	DATA FIELD(S) RE-ENTRY WITH SYSTEM GENERATED ASSISTS (HELPs)	1	1*	3
	SYSTEM OR USER/OPERATOR SEARCH AND EVALUATION	4	2	1

*Recommended for standardization purposes.

b. In a repetitive data entry task, when data validation for one transaction is completed, allow the user/operator to correct errors before another transaction can begin.

c. Allow the user/operator to return easily to previous steps in a transaction sequence in order to correct errors or make any other desired change.

d. When an error occurs in a menu command stack, program the computer to indicate where it stopped processing and which commands could not be processed.

e. To prompt for correction of an error in stacked commands, display the portion that needs to be corrected.

f. Allow the user/operator to control the amount of detail given in the explanation of error and in the content of the HELPs.

g. Display the changes in the state or value of altered items which result from user/operator correction.

h. Acknowledge all error corrections by the user/operator by indicating a correct entry has been made or by another error message.

i. Require the user/operator to modify only the incorrect portion of an input.

j. When a data entry transaction has been completed and errors have been detected, permit direct, immediate correction by the user/operator.

k. In an interactive session, when a user/operator is prompted by the system that an error has been detected, allow the user/operator to correct the error immediately.

l. When data entries or changes will be nullified by an abort action, require the user/operator to confirm the abort.

m. When a user/operator requests a HELP, present only the explanatory information appropriate to the particular data field currently being addressed.

7.2.6 ADVISORY COMMENTS ON ERROR CORRECTION AND RECOVERY

a. <u>Data field re-entry</u>.

1. Provide automatic cursor placement to the first character position of the data field to be re-entered.

2. Allow the user/operator, by simple key operation, to recall the erroneous input for evaluation.

b. <u>Data field re-entry with system generated assists (HELPs)</u>.

1. Link HELP files or menus to the specific error involved. In this way, the user/operator will call the relevant file when requesting additional information.

2. For multiple errors in one entry, link the HELP files to errors in the order in which they were entered.

c. <u>System or user/operator search and evaluation</u>.

1. Provide a step-through procedure for using the specified reference to assist inexperienced users/operators; do not provide them automatically.

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SECTION 8. USER/OPERATOR CONFIGURATIONS

Guidelines in this category address classes of individuals who perform direct operational transactions with the system. Note that these guidelines do not address "end users," those personnel such as the commander and members of his staff who use the system's products for decision making, but who seldom or never interact directly with system capabilities. The guidelines also do not address maintenance personnel or functions, except insofar as they have common features with operational personnel. Though maintenance is an important aspect of successful system operation, it is beyond the scope of this document.

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8.1 DEFINITION

User/operator configurations are the combinations of personnel, possessing similar or different sets of skills, required to operate the system's equipment, maintain its data stores, and generate its products. For purposes of these guidelines, the terms "operator" and "user" are defined arbitrarily as follows:

a. An "operator" does not personally make use of the system's data stores. An operator may enter data into the system, extract data from the system, and may manipulate data already stored in the system. However, such transactions are guided either by prepared paper forms, or by direct instructions of supervisory personnel. The operator seldom or never formulates queries or instructions to the system on individual initiative. Moreover, the operator seldom or never exercises independent judgment in determining the type, content, or format of system products.

b. A "user" may (and sometimes or even often does) perform some or most of the transactions of an operator. However, the user performs such transactions on individual initiative, in the course of some goal-centered task. The user normally receives requirements from some source outside the system (e.g., the commander, a member of the commander's staff, or some other "customer" of the system). The user then translates these requirements into appropriate menu selections, command statements, or entry parameters to provide the appropriate system products. The user also may exercise independent judgment in determining the type, content, or format of those products.

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8.2 APPLICATIONS FOR USER/OPERATOR CONFIGURATIONS

Users and/or operators must be provided in the system to perform each of the following tasks:

a. <u>Set up equipment following a move.</u>

EXAMPLE: A van-mounted artillery support system is shut down and moved periodically. When the new location is reached, protective covers must be removed, cables must be re-attached, system tapes and/or disks must be mounted, etc.

b. <u>Logon/Logoff</u>

EXAMPLE: The equipment operator must log on to the system before performing initialization or other operational functions. Users and other operators must log on before gaining access to system capabilities. Users and operators must log off to signal the system that they no longer need its capabilities.

c. <u>Initialize the system.</u>

EXAMPLE: After a move, a mobile command and control system is set up and the equipment operator logs on. To initialize the system, the operator must set up a "customer" table, relating each remote terminal to appropriate security levels, encryption devices, data bases, and categories of permissible messages.

d. <u>Coordinate workstations.</u>

EXAMPLE: In a supply inventory system, some of the system's remote terminals must be able to communicate with certain other terminals, but not with others. These requirements change depending on the specific functions being performed. The equipment operator must coordinate the various terminals to ensure the necessary communications capabilities and restrictions.

e. <u>Monitor system operations.</u>

EXAMPLE: In an intelligence information processing system, the equipment operator must monitor equipment to ensure that the central computer, tape drives, disk drives, printers, and remote terminals are operating properly. If malfunctions are detected, the operator may perform repairs personally, or summon maintenance personnel.

f. <u>Enter data.</u>

EXAMPLE: In a tactical command and control system, most of the incoming data enter the system data bases automatically, as digital signals from sensors or from affiliated systems. Users/operators occasionally enter data obtained from radio, telephone, or hard-copy messages.

EXAMPLE: In a personnel accounting system, virtually all data in the system's data bases are entered by personnel operating terminals transcribing from prepared paper forms.

g. Correct entry errors.

EXAMPLE: In an artillery support system, each data item is checked for validity immediately after entry. When an error is detected, the system provides immediate feedback and gives the user/operator an opportunity to correct the error.

EXAMPLE: In a supply inventory system, input data are loaded onto magnetic tapes at a peripheral computer. The system checks the data while reading the tape, and generates a hard-copy log of errors which is returned to personnel at the peripheral computer for correction.

h. Correct stored errors.

EXAMPLE: An intelligence analyst working with a graphic display discovers that a separate brigade has been aggregated into a division. Using picking and labeling procedures appropriate to the situation, the analyst separates the brigade from the division and identifies it correctly.

i. Update stored data.

EXAMPLE: A command and control support system contains data on the status of weapon systems in the division. As reports arrive concerning losses or replacements, an individual enters commands and data needed to reflect the changes to the data base.

j. Tabulate.

EXAMPLE: A personnel accounting system stores data on all personnel in a division. For periodic status reports, system software tabulates officers, warrant officers, and enlisted soldiers, broken down by combat, combat support, and combat service support specialties.

k. Aggregate.

EXAMPLE: An intelligence support system includes software to assign individual enemy entities such as tanks to identified parent units, on the basis of criteria supplied by the analyst.

l. Calculate.

EXAMPLE: An artillery support system receives data on target type and position. Using this data and information previously stored in effects tables, meteorological files, and gun characteristics files, the system calculates firing data for each battery in an artillery battalion.

m. Estimate.

EXAMPLE: As data are entered, tabulated, and aggregated according to analyst instructions, the system combines these data with previously-stored data about enemy forces. Based on the results of its calculations, system software generates an estimate of enemy strength in the sector.

n. Superimpose.

EXAMPLE: On the graphics screen of a tactical command and control support system, an analyst uses the capabilities of the system to place symbols and labels representing enemy forces on a display of terrain and cultural features.

EXAMPLE: An intelligence analyst uses system commands to call up a map display on a graphics screen. Using other commands, the analyst then calls up a software overlay of tactical boundary features (e.g., Forward Line of Own Troops, No Fire Line, etc.).

o. Translate.

EXAMPLE: Given a set of information requirements by an end user (e.g., the G-3), a command and control support system user converts these requirements into specifications for system products. That is, the user describes the types and amounts of information that must be retrieved from the system in order to satisfy the requirements.

p. Formulate.

EXAMPLE: Having translated end user information requirements into system product specifications, a command and control support system user formulates the sequence of commands, menu selections, pre-formatted form entries, and/or queries required to perform the data processing tasks necessary to generate the desired output.

q. Choose a data processing strategy.

EXAMPLE: By using different system capabilities in various ways, an intelligence analyst can generate an estimate of enemy strength by any of several command sequences. By interpreting end user information requirements in light of system characteristics, the analyst decides on the specific sequence to be used for the task.

r. Evaluate results of data processing.

EXAMPLE: An intelligence analyst examines an enemy strength estimate generated by the system. In light of experience in both intelligence analysis and system operations, the analyst evaluates the estimate. When the analyst delivers the estimate to the end user, the report includes an opinion as to the estimate's validity.

s. <u>Define system parameters.</u>

EXAMPLE: On the basis of evaluating system output products, an intelligence analyst determines that additional parameters should be used by the system in generating an enemy strength estimate. The analyst instructs the system to include those parameters in its processing procedures and then generate a new estimate. Depending on the particular situation and the reasons for including the additional data, the analyst may seek approval from higher authority to include one or more of these parameters permanently.

t. <u>Generate standard reports.</u>

EXAMPLE: A supply inventory system generates a variety of routine weekly, monthly, and annual reports. Each such report has a single, standard format; thus, the Monthly Consolidation Report always emerges from the system in the same format and contains the same data elements. To generate the report, the operator merely enters whatever data are required to bring the data base up to date, then selects the report name from a menu. The computer automatically performs all computations required, tabulates the data as necessary, and generates the report in the previously-defined format.

u. <u>Generate non-standard reports.</u>

EXAMPLE: The division commander lists the weapon systems, fuel types, ammo types, and personnel categories on which he wants daily status reports. These information types change from time to time, depending on the mission. Using the command language capabilities of the command and control support system, a user specifies the data types listed in the commander's guidance. The user then instructs the system to limit the retrieval process to data no more than 24 hours old, and formats the report in a manner to make it easily readable by the G-3 and commander.

8.3 BENEFITS OF USER/OPERATOR CONFIGURATIONS

Careful consideration of user/operator characteristics, duties, and skills, especially during early stages of system design, will help to assure an optimum "mix" of the personnel types required to perform the system's various functions. In addition, early consideration of these factors will help to avoid the situation in which a system is unwittingly designed for a higher level of personnel than is readily available. More specifically, careful assignment of system functions to appropriate types of users/operators will:

a. Reduce error rates:

   1. By encouraging performance of tasks which are within personnel capabilities.

   2. By eliminating boredom and frustration on the part of personnel by assignment to tasks that challenge their capabilities.

b. Increase system throughput rates, by enhancing the opportunity for personnel to perform tasks appropriate to their skills easily, confidentially, and accurately.

c. Increase job satisfaction, as occasioned by confidence and success of personnel performing tasks appropriate to their skills.

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8.4 METHODS FOR IMPLEMENTING DATA PROCESSING APPLICATIONS

This subsection is headed "Methods..." for consistency with other parts of this handbook. However, that heading is a misnomer, because the "methods" in this section are actually descriptions of personnel characteristics, duties, and skills related to system functions and operations. These characteristics, duties, and skills are allocated among five categories of operators and system users, as described below.

a. Equipment Operator.

1. Relevant Characteristics: Equipment operators generally will be lower-ranking enlisted personnel, with little or no specialized training except in computer operations. They may have received fundamental training in the functional area (e.g., artillery, armor, personnel, supply) supported by the system. However, their primary jobs will be computer operations, and they probably will have a computer-related MOS.

2. System-Related Duties: Equipment operators operate the computers and related machines at the system's central computer facility. They prepare the system for moves, ready the system for operations after moves (including initialization, if necessary), provide equipment resources as required (e.g., mount and dismount magnetic tapes and disks), and monitor the system to ensure that equipment functions properly. Depending on the system's design, equipment operators also may perform routine diagnostic and repair tasks.

3. Required Skills:

(a) Equipment operators must know the system's general electronic, electrical, and mechanical characteristics only in sufficient detail to enable them to disconnect and reconnect cables and perform other tear-down and set-up tasks during moves.

(b) They must know how to use features of system terminals related to logon/logoff, initialization, coordination of workstations, and monitoring activities.

(c) In connection with (b) above, they must know the system's software capabilities related to these activities (e.g., commands, menus, and/or on-line forms to be filled in connection with the initialization procedure).

(d) They need not know functional capabilities required to enter, correct, modify, or manipulate data; or to generate system products.

(e) They need not know the structures or contents of data bases, or of individual data records.

(f) They need not know the relationships among data records, or among data bases.

b. Data Entry Operator.

1. Relevant Characteristics: Data entry operators generally will be lower-ranking enlisted personnel. Normally, they will have been trained in the functional area (e.g., artillery, armor, personnel, supply) supported by the system, at least to the level of apprentices or clerks. Indeed, in many systems they will work part-time as operators and part-time as apprentices or clerks.

2. System-Related Duties: Data entry operators transcribe data into the system, either directly (i.e., on-line) or onto magnetic media which are read into the system subsequently. Data are provided to the operator on hard-copy forms, or less frequently by voice via radio, telephone, or a speaker near the data entry station. Data entry operators frequently will generate routine, standardized outputs (e.g., periodic hard-copy reports with invariant formats).

3. Required Skills:

(a) Data entry operators must know how to operate relevant features of terminals used for data entry (e.g., alphanumeric keyboard, numeric keypad, function keys related to data entry).

(b) They must know functional capabilities required to log on and off, to identify types of data to be entered (e.g., personnel promotion/reclassification, target identification, spare parts requisition, weapon system status), to enter data and correct entry errors, and to generate standardized reports.

(c) They need to know the structures of individual data records, but not the structures or contents of data bases.

(d) They need to know little or nothing about the electronic, electrical, or mechanical characteristics of the system.

(e) They do not need to know software capabilities required to modify or manipulate stored data, or to generate non-standard system products.

(f) They do not need to know the relationships among data records, or among data bases.

c. Data Base Operator.

1. Relevant Characteristics: Data base operators normally will be middle-ranking enlisted personnel. In addition to advanced training in the functional area (e.g., artillery, armor, personnel, supply) supported by the system, they also will have accumulated considerable experience. They may also have considerable experience with the new system's predecessor, if any. Often, they will divide their time between system operations and other duties in the functional area.

2. System-Related Duties: Data base operators basically perform operations of the system's data bases under supervision. They generally maintain the accuracy of data bases, correcting errors that were not detected during data entry, and updating data stores as necessary. They also manipulate stored data and generate non-standardized (i.e., customized) reports in accordance with instructions from supervisory personnel.

3. Required Skills:

(a) Data base operators must be familiar with all operational features of the terminal used for data base operations (e.g., alphanumeric keyboard, numeric keyboard, all function keys, graphic controls).

(b) They must be familiar with functional capabilities required to modify and manipulate stored data and to generate output reports.

(c) They must be familiar with software capabilities required to log on and off, and to enter and correct data.

(d) They must be familiar with the structures of individual data records, and the structures and contents of data bases.

(e) They need know little or nothing about the electronic, electrical, or mechanical characteristics of the system.

(f) They need not know the relationships among individual data records, or among data bases.

d. Data Base User.

1. Relevant Characteristics: Data base users might be thought of as "upgraded" data base operators. Generally, they will be middle-level enlisted personnel. They will have received advanced training in the functional area (e.g., artillery, armor, personnel, supply), and will have accumulated substantial experience in the functional area. They will also have had substantial experience with any predecessors of the new system. They normally will have considerable functional duties outside the system, and will use the system as one of their tools in functional performance.

2. System-Related Duties: Data base users exercise independent judgment in translating system output requirements into system processing tasks. They perform these tasks, and generate non-standardized (i.e., customized) reports to satisfy system output requirements without supervision. Under supervision, they may also perform decision-related functions normally performed by "System Users" (described below).

3. Required Skills:

   (a) Data base users must know all relevant features of the system's terminals.

   (b) They must be familiar with all system capabilities, except those required for routine operations (e.g., initialization).

   (c) They must know thoroughly the structures of individual data records, and the structures and contents of data bases.

   (d) They must be familiar with the relationships among data records and among data bases.

c. <u>System User</u>.

1. Relevant Characteristics: System users are senior NCOs or officers. They have received most or all formal training available in the functional area (e.g., artillery, armor, personnel, supply), and will have accumulated extensive experience in the functional area. If the new system has a predecessor system, they will have been among its most skilled users/operators. The system will be but one of the tools they use in performing their functional duties.

2. System-Related Duties: Given an "end user" requirement (e.g., a demand from the commander for information about current enemy intentions), the system user will formulate system output requirements that will satisfy the end user requirement. The system user may then hand off the job to a data base operator, or go ahead to translate system output requirements into specific data processing tasks, which may or may not be performed personally. The system user will then evaluate the results for conformance with the end user requirement. If necessary, other data processing strategies may be chosen, and additional system parameters may be defined. Then, processing is performed again to generate more useful results.

3. Required Skills: The system user combines all of the skills of other users/operators, particularly those of data base operator and data base user, though at a level of greater expertise.

8.5 RECOMMENDATIONS FOR USER/OPERATOR CONFIGURATIONS

a. In deciding whether to automate a given system function or to assign it to a human being, consider the training and skills of the personnel who will be available to staff the system. Table 8.5-1 lists applications (system functions) and user/operator types, and provides recommendations regarding assignment of functions to users/operators.

b. Do NOT assume that system functional capabilities can be designed without regard to user/operator types. *Find out* what kinds of personnel will be available to staff the system *before* designing the system. That is, before designing an artillery support system, check with the Artillery School and other subject matter experts about personnel availability in the out years (instead of assuming, for example, ample availability of experienced senior NCOs).

c. If a function would force a lower-level user/operator (e.g., a data base operator) to perform *above* normal capabilities *occasionally*, but would force the next higher-level user/operator (e.g., a data base user) to perform *below* normal capabilities *occasionally*, assign the function to the higher-level user/operator.

d. If a function would force a lower-level user/operator (e.g., a data base operator) to perform *above* normal capabilities *consistently*, but would force the next higher-level user/operator (e.g., a data base user) to perform *below* normal capabilities *consistently*, redesign the function for compatibility with one type of user/operator.

e. Do NOT assume that additional training will overcome deficiencies in performance caused by inappropriate assignment of system functions to user/operator types. Training *might* overcome such deficiencies, but it probably won't. The only certainty in regard to this issue is that adding training will increase the burden on the schools and the using units, and add to the cost of the system over its life.

f. When more than one user/operator is logged onto the system, make sure that inputs by one individual do not interfere with any other individual's work. EXCEPTION: A higher-level or supervisory user may need to transmit a priority message for immediate execution by a lower-level or subordinate user/operator. In this event, save the entire task on which the latter individual is working at the time of interruption, so that complete recovery can be made later. (See Section 3.3 Interrupts and Work Recovery.)

g. When users/operators communicate with each other via on-line messages, always identify the sender of a message.

Table 8.5-1. Recommendations for Assigning System Functions According to User/Operator Type

USER/OPERATOR TYPE	APPLICATIONS (SYSTEM FUNCTIONS)																							
	SYSTEM OPERATION FUNCTIONS					INPUT FUNC-TIONS		DATA PROCESSING (DP) FUNCTIONS							DECISION-RELATED FUNCTIONS					OUTPUT FUNCTIONS				
								MODIFY		MANIPULATED STORED DATA							EXPLORE ALTERNA-TIVES				GENERATE NON-STANDARD REPORTS		
	Set Up Equipment	Log on/off	Initialize	Coordinate Workstations	Monitor Systems Operations	Enter Data	Correct Entry Errors	Correct Stored Errors	Update Stored Data	Tabulate	Aggregate	Estimate	Calculate	Superimpose	Translate	Formulate	Choose Dp Strategy	Evaluate Results	Define System Parameters	Generate Standard Reports	Specify Type	Specify Limits	Specify Format
EQUIPMENT OPERATOR	1	1	1	1	1	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DATA ENTRY OPERATOR	2	1	2	2	2	1	1	4	4	4	4	4	4	4	4	4	4	4	4	1	4	4	4
DATA BASE OPERATOR	4	1	4	4	4	3	3	1	1	2	2	2	2	2	4	4	4	4	4	1	2	2	2
DATA BASE USER	4	1	4	4	4	3	3	3	3	1	1	1	1	1	1	2	2	2	2	3	1	1	1
SYSTEM USER	4	1	4	4	4	3	3	3	3	3	3	3	3	3	1	1	1	1	1	3	3	3	3

KEY:

1 = Highly appropriate function, given the user's/operator's training and skills.

2 = Appropriate function, but only if the user/operator is given adequate assistance/supervision.

3 = Normally inappropriate function, but may be performed occasionally during performance of more appropriate functions.

4 = Highly inappropriate function: imposes excessive burden on the user/operator, or else wastes user/operator training and skills.

h. If a display screen will be used by more than one user/ operator, provide a cursor for each individual.

i. Provide storage for separate personal files for each user/ operator of the system.

j. Maintain a permanent record of all messages sent from any user/operator to any other.

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BIBLIOGRAPHY

Addis, T. R. "Machine Understanding of Natural Language." International Journal of Man-Machine Studies, 1977, 9, 207-222.

Atkinson, P., Dalvi, V. S., Drawneek, E. A., Fellgett, P. B., Hovland, H. L., Tring, R. W. H., Walker, B. S., and Whitfield, G. R. "The Picasso Low-Cost System in Relation to Graphic Communication as a Natural Language for Man-Computer Interaction." Man-Computer Interaction, 1970, 172-180.

Baker, J. D., and Goldstein, I. "Batch vs. Sequential Displays: Effects on Human Problem Solving." Human Factors, 1966, 8, 225-235.

Barmack, J. E., and Sinajko, H. W. Human Factors Problems in Computer-Generated Graphic Displays (Report No. S-234). Arlington, Virginia: Institute for Defense Analyses, April 1966. (NTIS No. AD 636170).

Bennett, J. W. "The User Interface in Interactive Systems." In C. A. Caudra (Ed.) Annual Review of Information Science and Technology, 7, 1972, 159-196.

Biberman, L. M. (Ed.) Perception of Displayed Information. New York: Plenum Press, 1973.

Boomer, H. R. "Relative Comprehensibility of Pictorial Information and Printed Words in Proceduralized Instructions." Human Factors, 1975, 17, 266-277.

Bryden, J. E. "Design Considerations for Computer Driven CRT Displays." Computer Design, March 1969, 8(3), 38-46.

Buckler, A. T. A Review of the Literature on the Legibility of Alphanumerics on Electronic Displays (Technical Memorandum 16-77). Aberdeen Proving Ground, Maryland: U. S. Army Human Engineering Lab., May 1977. (NTIS No. AD A040625)

Callan, J. R., Curran, L. E., and Lane, J. L. Visual Search Times for Navy Tactical Information Displays (Report No. MPRDC-TR-77-32). San Diego, California: Navy Personnel Research and Development Center, May 1977. (NTIS No. AD A040543)

Chamberlain, R. G. "Conventions for Interactive Computer Programs." Interfaces, November 1975 (PT. 1), 6(1), 77-82.

Chapanis, A. "The Communication of Factual Information through Various Channels." Information Storage and Retrieval, 1973, 9, 215-231.

Chapanis, A. "Interactive Human Communication." Scientific American, March 1975, 232(3), 36-42.

Chapanis, A. Human Factors in Teleconferencing Systems (Technical Report No. NSF/RA-760575). Baltimore, Maryland: Johns Hopkins University, November 1976. (NTIS No. PB 268453)

Chapanis, A., Ochsman, R. B., Parrish, R. N., and Weeks, G. D. "Studies in Interactive Communication: I. The Effects of Four Communication Modes on the Behavior of Teams during Cooperative Problem-Solving." Human Factors, 1972, 14, 487-509.

Chapanis, A., and Overbey, C. M. "Studies in Interactive Communication: III. Effects of Similar and Dissimilar Communication Channels and Two Interchange Options on Team Problem Solving." Perceptual and Motor Skills, 1974, 38, 343-374. (Monograph)

Chapanis, A., Parrish, R. N., Ochsman, R. B., and Weeks, G. D. "Studies in Interactive Communication: II. The Effects of Four Communication Modes on the Linguistic Performance of Teams during Cooperative Problem Solving." Human Factors, 1977, 19, 101-126.

Cheriton, D. R. "Man-Machine Interface Design for Timesharing Systems." ACM '76: Proceedings of the Annual Conference, 1976, 362-366.

Christ, R. E. "Review and Analysis of Color Coding Research for Visual Displays." Human Factors, 1975, 17, 542-570.

Christ, R. E., and Corso, G. M. Color Research for Visual Displays (Report No. ONR-CR213-102-3). Las Cruces, New Mexico: New Mexico State University, Department of Psychology, July 1975.

Clarke, D. C. "Query Formulation for On-Line Reference Retrieval: Design Considerations from the Indexer/Searcher Viewpoint." Proceedings of the American Society for Information Science, 1970, 7, 83-86.

Codd, E. F., Seven Steps to Rendezvous with the Casual User (Technical Report RJ-1333). San Jose, California: IBM Research Laboratory, January 1974.

Conrad, R. "Short-Term Memory Factor in the Design of Data-Entry Keyboards: An Interface Between Short-Term Memory and S-R Compatibility. "Journal of Applied Psychology, 1966, 50, 353-356

Danchak, M. M. "CRT Displays for Power Plants." Instrumentation Technology, October 1976, 23(10), 29-36.

Day, C. W., and Ziamerman, L. L. "Implementation and Usage." IBM Systems Journal, 1968, 7, 373-381.

DeGreene, K. B. Systems Psychology. New York, McGraw Hill, 1970.

Dinter, H. "Design Criteria for a Man-Machine Information Transfer System." In L. Schultz (Ed.), The Information Bazaar: 6th Annual National Colloquium on Information Retrieval. Philadelphia, Pennsylvania: The College of Physicians of Philadelphia, Medical Documentation Service, 1969, 15-22.

Dolotta, T. A. "Functional Specifications for Typewriter-Like Time-Sharing Terminals." Computing Surveys, 1970, 2, 5-31.

Doherty, W. J., Thompson, C. M., and Boies, S. J. "An Analysis of Interactive System Usage with Respect to Software, Linguistic, and Scheduling Attributes." Proceedings of the 1972 International Conference on Cybernetics and Society, 1972, 113-119 (also Technical Report RC-3914, Yorktown Heights, New York: IBM Watson Research Center, 1972).

Durding, B. H., Becker, C. A., and Gould, J. D. Data Organization (Research Report RC-4956). Yorktown Heights, New York: IBM Watson Research Center, July 1974.

Earl, W. K., and Goff, J. D. "Comparison of Two Data Entry Methods." Perceptual and Motor Skills, 1965, 20, 369-384.

Eason, K. "Human Relationships and User Involvement in Systems Design." Computer Management, May 1977, 10-12.

Eason, K. D., Damodaran, L., and Stewart, T. F. M. "Interface Problems in Man-Computer Interaction." In E. Mumford and H. Sackhan (Eds.), Human Choice and Computers. Amsterdam: North-Holland, 1975, 91-105.

Ehrenreich, S. L. Query Language: Design Recommendations Derived from the Human Factors Literature. Alexandria, Virginia: Army Research Institute Technical Report No. 484 (in press).

Engel, S. R., and Granda, R. E. Guidelines for Man/Display Interfaces (Technical Report TR 00.2720). Poughkeepsie, New York: IBM Poughkeepsie Laboratory December 1975.

English, W. K., Engelbart, D. C., and Berman, M. L. "Display-Selection Techniques for Text Manipulation." IRE Transactions on Human Factors in Electronics, 1967, HFE-8, 5-15.

Fetter, R. B., and Carlisle, J. H. Man-Computer Interaction in a Decisionmaking Environment (Report No. 1). New Haven, Connecticut: Yale University, Department of Administrative Sciences, March 1971. (NTIS No. AD 722336).

Fields, A. F., Maisano, R. E., and Marshall, C. F. A Comparative Analysis of Methods for Tactical Data Inputting. Alexandria, Virginia: Army Research Institute Technical Report No. 327, 1978.

Foley, J. D., and Wallace, V. L. "The Art of Natural Graphic Man-Machine Conversation." Proceedings of the IEEE, 1974, 62, 462-471.

Franklin, J., and Dean, E. "Some Expected and Not So Expected Reactions to a Computer-Aided Design with Interactive Graphics (CANDIG) System." SIC Journal, May-June 1974, 9, 5-6, 11-13.

BIBLIOGRAPHY (Continued)

Gade, P. A., Fields, A. F., and Alderman, I. N. Selective Feedback as a Training Aid to On-Line Tactical Data Inputting. Alexandria, Virginia: Army Research Institute Technical Paper No. 349, November 1978. (AD A061 789).

Gagne, R. M., et al. Psychological Principles in System Development. New York: Holt, Rinehart and Winston, 1963.

Gilb, T., and Weinberg, G. "Humanizing Data Entry by Default." Datamation, August 1976, 22(8), 73-76.

Goodwin, N. C. "Cursor Positioning on an Electronic Display Using Lightpen, Lightgun, or Keyboard for Three Basic Tasks." Human Factors, 1975, 17, 289-295.

Gould, J. D. "Visual Factors in the Design of Computer-Controlled CRT Displays." Human Factors, 1968, 10, 359-375.

Gould, J. D., and Ascher, R. M. Use of an IQF-Like Query Language by Non-Programmers (Research Report No. 2C-5279). Yorktown Heights, New York: IBM Watson Research Center, February 1975 (also presented at the annual meeting of the American Psychological Association, New Orleans, Louisiana, September 1974).

Gould, J. D., Lewis C., and Becker, C. A. Writing and Following Procedural, Descriptive, and Restricted Syntax Language Instructions (Research Report No. RC-5943). Yorktown Heights, New York: IBM Watson Research Center, April 1976.

Greene, E. E. "Message Design: Graphic Display Strategies for Instruction." ACM '76: Proceedings of the Annual Conference, 1976, 144-148.

Gretner, W. F., and Baker, C. A. "Visual Presentation of Information." In H. P. Van Cott and R. G. Kikkade (Eds.), Human Engineering Guide to Equipment Design (Rev. ED.). Washington, D.C.: U.S. Government Printing Office, 1972, 41-121.

Guttmann, H. E., and Anderson, D. A. Studies Comparing Effectiveness of Three-Dimensional Versus Two-Dimensional Presentations (Report No. 1525-TR1). Minneapolis, Minnesota: Minneapolis-Honeywell Regulator Company, Military Products Group, November 1962.

Hanes, L. F. "Human Factors in International Keyboard Arrangement." In A. Chapanis (Ed.), Ethnic Variables in Human Factors Engineering. Baltimore: Johns Hopkins University Press, 1975, 189-206.

Hanes, L. F., and Kinkead, R. D. "Research in Manual Data Entry" (NCR Human Factors Report AT-47-18). Presented at the annual meeting of the Human Factors Society, New York, October 1971.

Haynan, E. "Design Criteria for CRT Alphanumeric Displays." Proceedings of the International Symposium on Man-Machine Systems, 8-12 September 1969, 4.

Heafner, J. F. Protocol Analysis of Man-Computer Languages: Design and Preliminary Findings (Report No. ISI/RR-75-34). Marina Del Rey, California: University of Southern California, Information Sciences Institute, July 1975. (NTIS No. AD A13568)

Heglin, H. J., Saben, R., and Driver, L. L. "Digital Message Entry Device (DMED) Human Factors Analysis." Proceedings of the 16th Annual Meeting of the Human Factors Society, 1972, 403-409.

Helps, F. G. "Minimizing Human Problems when Introducing Automation." Applied Ergonomics, 1970, 1, 130-133.

Hill, I. D. "Wouldn't It Be Nice If We Could Write Computer Programs In Ordinary English--Or Would It?" Computer Bulletin, June 1972, 16(6), 306-312.

Hitt, W. D., Schutz, H. G., Christner, C. A., Ray, H. W., and Coffey, L. J. "Development of Design Criteria for Intelligence Display Formats." Human Factors, 1961, 3, 86-92.

Hobbs, J. R. "What the Nature of Natural Language Tells Us About How to Make Natural-Language-Like Programming Languages More Natural." Proceedings of the ACM Symposium on Artificial Intelligence and Programming Languages, Sigplan Notices, August 1977, 12(8), 85-93 (Also: Sigart Newsletter, August 1977, 64, 85-93.)

Hoisman, A. J., Hannah, L. D., and Scharf, E. An Experimental Investigation of Intelligence Information Display Parameters (Report No. RADC-TDR-63-378). Griffiss Air Force Base, New York: Rome Air Development Center, September 1963. (NTIS No. AD 422076).

Irving, G. W., Horinek, J. J., Walsh, D. H., and Chan, P. Y. ODA Pilot Study II: Selection of an Interactive Graphics Control Device for Continuous Subjective Functions Applications (Report No. 215-2). Santa Monica, California: Integrated Sciences Corp., April 1976.

Jenny, J. A. "The Crucial Element in Effective Computer Utilization is Man-Machine Interaction." Automation, May 1973, 20(4), 72-76.

Karner, C. "Perceived Versus Actual Value of Color-Coding." In Proceedings of the 19th Annual Meeting of the Human Factors Society, 1975, 227-231.

Kennedy, T. C. S. "The Design of Interactive Procedures for Man-Machine Communication." International Journal of the Man-Machine Studies, 1974, 6, 309, 334.

Licklider, J. C. R. "Man-Computer Symbiosis." IRE Transactions on Human Factors in Electronics, 1960, HFE-1, 4-11.

Lipow, M. Estimation of Software Package Residual Error (Technical Report No. TRW-SS-72-09). Redondo Beach, California: TRW, November 1972.

Loeser, R., and Gaposchkin, E. M. "The Second Law of Debugging." Software-Practice and Experience, 1976, 6, 577-578.

Mace, D. J., Harrison, P. C., Jr., and Segum, E. L. Prevention and Remediation of Human Input Errors in ADP Operations. Alexandria, Virginia: Army Research Institute Technical Report No. 395, August 1979 (AD A081 730).

Martin, J. Design of Man-Computer Dialogues. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Martin, T. H. "The User Interface in Interactive Systems." In C. A. Caudra and A. W. Luke (Eds.), Annual Review of Information Science and Technology, 1973, 8, 203-219.

Mezrich, J. J., Carlson, C. R., and Cohen, R. W. Image Descriptions for Displays (Technical Report No. PRRL-77-CR-7). Princeton, New Jersey: RCA Laboratories, February 1977. (NTIS No. AD A042492).

Miller, L. A. "Programming by Non-Programmers." International Journal of Man-Machine Studies, 1974, 6, 237-260 (Also: Research Report RC-4280, Yorktown Heights, New York: IBM Watson Research Center, 1973)

Montgomery, C. A. "Is Natural Language an Unnatural Query Language." Proceedings of the Association for Computer Machinery, 1972, 1075-1078.

Morrill, C. S., Goodwin, N. C., and S ith, S. L. "User Input Mode and Computer-Aided Instruction." Human Factors, 1968, 10, 225-232.

Morris, I. L. "Human Factors for Interactive Systems." In R. D. Murray (Ed.), Computer Handling of Graphical Information. Washington, D.C.: Society of Photographic Scientists and Engineers, 1970, 87-91.

Moses, F. L., and Potash, L. M. Assessment of Abbreviation Methods for Automated Tactical Systems. Alexandria, Virginia: Army Research Institute Technical Report No. 398, August 1979. (AD A077 840)

Muckler, F. A., and Obermayer, R. W. "Information Display." International Science and Technology, August 1965, 34-40.

Nawrocki, L. H. Alpha-Numeric Versus Graphic Displays in a Problem-Solving Task (Technical Research Note 227). Arlington, Virginia: U.S. Army Behavior and Systems Research Laboratory, September 1972. (NTIS No. AD 748799)

Nawrocki, L. H., Strub, H. H., and Cecil, R. M. "Error Categorization and Analysis in Man-Computer Communication Systems." IEEE Transactions on Reliability, 1973, R-22, 135-140.

Neal, A. S. "Time Intervals Between Keystrokes, Records, and Fields in Data Entry with Skilled Operators." Human Factors, 1977, 19, 163-170 (Also: Technical Report HFC-8. San Jose, California: IBM Corp., System Development Division, Human Factors Center, October 1974.)

Nicholson, R. M., Wiggins, B. D., and Silver, C. A. An Investigation into Software Structures for Man/Machine Interactions. Arlington, Virginia: Analytics, Inc., February 1972. (NTIS No. AD 737266)

Nystrom, C. O., and Gividen, G. M. Ease of Learning Alternative TOS Message Reference Codes. Alexandria, Virginia: Army Research Institute Technical Paper No. 326, September 1978. (AD A061 697)

Operating Systems, Inc. MIQSTURE; An Experimental On-Line Language for Army Tactical Intelligence Information Processing. Alexandria, Virginia: Army Research Institute Technical Paper No. TR-78-A-25, July 1978. (AD A064 323)

Obermayer, R. W. "Accuracy and Timeliness in Large-Scale Data-Entry Subsystems." Proceedings of the 21st Annual Meeting of the Human Factors Society, 1977, 173-177.

Owsowitz, S., and Sweetland, S. Factors Affecting Coding Errors (Report No. RM-4346-PR). Santa Monica, California: Rand Corp., April 1965. (NTIS No. AD 61-415)

Parrish, R. N. "The Linguistic Performance of Males and Females During Cooperative Problem Solving." Presented at the annual meeting of the Western Psychological Association, April, 1978.

Parrish, R. N., Gates, J. L., and Munger, S. J. Phase I Final Report, Volume V: Background Literature Relevant to Human Factor Guidelines and Criteria for the Design of User/Operator Transactions, Fairfax, Virginia: Synectics Corporation, February 1981.

Parrish, R. N., Ochsman, R. E., and Chapanis, A. "Studies in Man-Computer Communication: I. The Effects of Four Communication Modes on the Efficiency of Team Problem Solving." Presented at the 42nd Annual Meeting of the Eastern Psychological Association, New York, April 1971.

Parrish, R. N., Gates, J. L., and Munger, S. J. Development of Design Guidelines and Criteria for User/Operator Transactions with Battlefield Automated Systems. Phase I Final Report (5 Volumes). Fairfax, Virginia: Synectics Corporation, 1981.

Parrish, R. N., Smith, L. T., Gates, J. L., and Munger, S. J. Development of Design Guidelines and Criteria for User/Operator Transactions with Battlefield Automated Systems: Phase II Interim Report. Research Issues in User/Operator Transactions: Review of the Literature. Fairfax, Virginia: Synectics Corporation, August 1981.

Petrick, S. R. "On Natural Language Based Computer Systems." IBM Journal of Research and Development, 1976, 20, 314-325.

Ramsey, H. R. and Atwood, M. E. Human Factors in Computer Systems; A Review of the Literature. Englewood, California: Science Applications, Inc., 21 September 1979.

Ramsey, H. R., Atwood, M. E., and Kirshbaum, P. J. A Critically Annotated Bibliography of the Literature of Human Factors in Computer Systems. Englewood, California: Science Applications, Inc., 1978.

Reisner, P. "Use of Psychological Experimental as an Aid to Development of a Query Language." IEEE Transactions on Software Engineering, May 1977, SE-3, 218-229.

Reisner, P., Boyce, R. F., and Chamberline, D. D. "Human Factors Evaluation of Two Data Base Query Languages: Square and Sequel." AFIPS Conference Proceedings, 1975, 44, 447-452.

Ridsdale, B. "The Non-Specialist User and the Computer Terminal." In Man-Computer Interaction: Proceedings, Conference on Man-Computer Interaction. (Conference Publication No. 38), 1970, 153-159.

Sawyer, C. R., Fiorello, M., Kidd, J. S., and Price, H. E. Measuring and Enhancing the Contribution of Human Factors in Military System Development; Case Studies of the Application of Impact Assessment Methodologies (Draft Final Report). Alexandria, Virginia: ARI Technical Report (in press).

Saenz, N. E., and Riche, C. V., Jr. "Shape and Color as Dimensions of a Visual Redundant Code." Human Factors, 1974, 16, 308-313.

Schoonard, J. J., and Boies, S. J. "Short-Type: A Behavioral Analysis of Typing and Text Entry." Human Factors, 1975, 17, 203-214.

Schutz, H. G. "An Evaluation of Formats for Graphic Trend Displays: Experiment II." Human Factors, 1961, 3, 99-107.

Schutz, H. G. "An Evaluation of Methods for Presentation of Graphic Multiple Trends: Experiment III." Human Factors, 1961, 3, 108-119.

Shapiro, S. C., and Swansy, S. C. Interactive Consulting via Natural Language (Technical Report No. 12). Bloomington, Indiana: Indiana University, Computer Science Department, 1974.

Schneiderman, B. "Improving the Human Factors Aspect of Data Base Interactions." ACM Transactions on Data Base Systems, 1978.

Schneiderman, B. Software Psychology: Human Factors in Computer and Information Systems. Cambridge, Massachusetts: Winthrop Publishers, Inc., 1980.

Schooman, M. L., and Bolsky, M. I. "Types, Distribution, and Test and Correction Times for Programming Errors." Proceedings of the 1975 International Conference on Software, Sigplar Notices, June 1975, 10(6), 347-357.

Simanis, A. "Human Factors in Interactive Computer Graphics." Proceedings Fourth Man-Computer Communications Conference. Ottawa, Ontario, Canada: National Research Council of Canada, 1975, pp. 8-1 to 8-12.

Slaughter, J. B. "Interactive Displays in Tactical Command and Control." Paper presented at Wincon 75, Los Angeles, February 1975.

Smith, J. M. An Oral Experiment on Retrieval Dialogue. Philadelphia, Pennsylvania: University of Pennsylvania, Moore School of Electrical Engineering, June 1967. (NTIS No. AD 674058)

Smith, J. M. A Written Experiment on Retrieval Dialogue. Philadelphia, Pennsylvania: University of Pennsylvania, Moore School of Electrical Engineering, August 1967. (NTIS No. AD 673900)

Smith, S. L. "Legibility of Overprinted Symbols in Multi-Colored Displays." Journal of Engineering Psychology, 1963a, 2, 82-96.

Smith, S. L. "Man-Computer Information Transfer." In J. H. Howard, (Ed.), Electronic Information Display Systems. Washington, D.C.: Spartan Books, 1963b, 284-299.

Smith, S. L. "Color Coding and Visual Separability in Information Displays." Journal of Applied Psychology, 1963c, 47, 358-364.

Smith, S. L. "Color Coding Displays for Data-Processing Systems." Electro-Technology, 1963d, 71(4), 63-69.

Smith, S. L. Guidelines for Man-Computer Interaction in Communication Systems (Technical Report MTR-2913). Bedford, Massachusetts: Mitre Corp., 1974.

Smith, S. L. Requirements Definition and Design Guidelines for the Man-Machine Interface in C^3 System Acquisition. Bedford, Massachusetts: Mitre Corporation, 31 December 1979. (Mitre Technical Report MTR-3888)

Smith, S. L. Man-Machine Interface (MMI) Requirements Definition and Design Guidelines: A Progress Report. Bedford, Massachusetts: Mitre Corporation, 30 September 1980. (Mitre Technical Report MTR-8134)

Smith, S. L. and Goodwin, N. C. "Blink Coding for Information Display." Human Factors, 1971, 13, 283-290.

Smith, S. L. and Goodwin, N. C. "Another Look at Blinking Displays." Human Factors, 1972, 14, 345-347.

Smith, S. L., and Thomas, D. W. "Color Versus Shape Coding in Information Displays." Journal of Applies Psychology, 1964, 137-146.

Sterling, T. D. "Guidelines for Humanizing Computerized Information Systems: A Report from Stanley House." Communications of the ACM, 1974, 17, 609-613.

Sterling, T. D. "Humanizing Computerized Information Systems." Science, 1975. 190, 1168-1172.

Stewart, T. F. M. "Displays and the Software Interface." Applied Ergonomics, 1976, 7, 137-146.

Stewart, T. F. M. "Display System Design for Improved Operator Organization." Proceedings, IEE Displays Conference, 1977, 82-85.

Stewart, T. F. M. Oestberg, O., and MacKay, C. J. Computer Terminal Ergonomics: A Review of Recent Human Factors Literature. Stockholm, Sweden: Statskontoret, 1974. (Available from Statskontoret, Fack, S-10026, Stockholm, Sweden.)

Strub, M. H. Evaluation of Man-Computer Input Techniques for Military Information Systems (Technical Research Note 2?6). Arlington, Virginia: U.S. Army Behavior and Systems Research Laboratory, May 1971. (NTIS No. AD 730315)

Strub, M. H. Automated Aids to On-Line Data Inputting. Alexandria, Virginia: Army Research Institute Technical Research Note 262, February 1975. (AD A0130350)

Sullivan, D. J., and Meister, D. Research Requirements for the Human Engineering Design of Visual Displays (Technical Report H0069-906). Canoga Park, California: Bunker-Ramo Corp., December 1969. (NTIS No. AD 701790)

Teichner, W. H., Christ, R. E., and Corso, G. M. Color Research for Visual Displays (Report No. OMR-CR213-102-4F). Las Cruces, New Mexico: New Mexico State University, Department of Psychology, June 1977. (NTIS No. AD A043609)

Testa, C. J. "Behavioral Factors in Information Systems." Computers and People, April 1974, 23(4), 13-17.

Thomas, J. C. Qualifiers and Question-Asking (Technical Report No. RC 4866). Yorktown Heights, New York: IBM Watson Research Center, February 1976. (NTIS No. AD A043043)

Thomas, J. C., and Gould, J. D. "A Psychological Study of Query by Example." AFIPS Conference Proceedings, 1975, 44, 439-445 (also IBM Report RC-5123, Yorktown Heights, New York: IBM Watson Research Center, November 1974).

Thompson, D. A. "Man-Computer System: Toward Balanced Cooperation in Intellectual Activities." In Proceedings, International Symposium on Man-Machine Systems (IEEE Conference Record No. 69058-MMS)(Vol. 1). New York: Institute of Electrical and Electronics Engineers, September 1969.

Thompson, D. A. "Interface Design for an Interactive Information Retrieval System: A Literature Survey and a Research System Description." Journal of the American Society for Information Science, 1971, 22, 361-373.

Ton, W. H. "Optimal Visual Characteristics for Large Screen Displays." Information Display, July/August 1969, 6(4), 48-52.

Varley, T. C. Data Input Error Detection and Correction Procedures (Technical Report No. T-222). Washington, D.C.: George Washington University, 1969. (NTIS No. AD 689365)

Vartabedian, A. G. "Effects of Parameters of Symbol Formation of Legibility." Information Display, May 1970, 7(5), 23-26.

Vaughan, W. S., Jr., and Mavor, A. S. "Behavioral Characteristics of Men in the Performance of Some Decision-Making Task Components." Ergonomics, 1977, 15, 267-277.

Vicino, F. L., and Ringel, S. Decision Making with Updated Graphic vs. Alpha-Numeric Information (Technical Research No. 175). Washington, D.C.: Army Personnel Research Office, November 1966. (NTIS No. AD 647621)

Vitz, P. C. "Preference for Different Amounts of Visual Complexity." Behavioral Science, 1966, 11, 105-114.

Vlahos, P. "The Three-Dimensional Display: Its Cues and Techniques." Information Display, November-December 1965, 2(6), 10; 13-20.

Wallace, V. L. "The Semantics of Graphic Input Devices." Proceedings, ACM Symposium on Graphic Languages, Sigplan Notices, June 1976, 11(6), 61-65.

Williges, B. H., and Williges, R. C. User Considerations in Computer Based Information Systems. Blacksburg, Virginia: Virginia Polytechnical Institute and State University, 1981.

Wood, R. C. "Inferences from the JCSB On-Line System for Man-System Interface Design. Proceedings of the 1972 International Conference on Cybernetics and Society, 1972, 120-125.

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